Second consultation on assessment of future mobile competition and proposals for the award of 800MHz and 2.6GHz spectrum and related issues

Summary

Vodafone commends Ofcom for taking note of the responses to its previous consultation and making important changes to the analysis and reasoning underpinning its proposed auction rules.

However we believe that there are still important shortcomings in Ofcom's approach which will require changes to the auction rules. In this response we highlight a number of matters:

- Ofcom reserves spectrum for a 'fourth operator' by concluding that, if the auction were allowed to run freely, there is a material risk that this operator would be left with insufficient spectrum. However, on close analysis, the chances of this happening are vanishingly small. The fourth operator's 'intrinsic' value for new spectrum is almost certainly higher than one or more of its rivals because it must have it to survive and 'strategic investment' on the part of others to thwart this is too costly and uncertain a strategy to be either credible or possible. Spectrum reservation is a needless sledgehammer to crack an invisible nut and should not be contemplated given the attendant risks of inefficient spectrum use.

- If Ofcom is still minded to conclude that some reservation of spectrum is appropriate, there is no convincing and proportionate case that it should extend to the 2.6GHz band. In other auctions throughout Europe no fourth operator that has wanted this spectrum has failed to acquire it; no operator has been weakened by strategic bidding on the part of others and two operators in Europe have thought that they do not even need 2.6GHz spectrum, relying instead on spectrum at 1800MHz and below. The latter is not surprising because our technical analysis, consistent with the merger decision of the European Commission, indicates that the spectrum portfolios in the smaller group are sufficient for a fourth operator to be a credible force in the market.

- Our approach, of (at least) restricting any spectrum reservation to the small portfolio, will avoid the problem identified in the addendum to this consultation because if a 'new' operator buys the divested spectrum then there is no need to reserve any spectrum for anyone. Failing this, Ofcom should favour Case 1. If it is right about the amount of spectrum required to be credible, then the smaller operators will share their spectrum purchases and Ofcom, by its own logic, will encourage this enhancement of competition. If, as we argue, Ofcom is wrong, then the purchaser of the divested block will have sufficient spectrum to be a credible competitor.

- The current proposals for annual licence fees lack sufficient clarity for operators to be able to make well informed bids in the forthcoming auction or in any private sale of the 1800MHz spectrum. The proposed use of auction prices to set the ALF for the 900 and 1800MHz bands still risks distorting the auction despite the inclusion of the novel Additional Spectrum Methodology. It incentivises those paying ALF to shade their bids and those who do not to inflate the costs of their competitors. Even without these distortions Ofcom's own analysis shows that the price of 800MHz spectrum is not a good proxy for the market value of 900MHz because, at least in the medium term, the latter is not a substitute for the former.

- Ofcom can overcome these shortcomings and reduce uncertainty in the auction. It should include and endorse a fourth methodology: the technical and cost analysis proposed by Vodafone in its response to the previous consultation and adopted by Ofcom as its preferred methodology for other spectrum bands (and previously for 900 and 1800MHz). It should give particular weight to this approach together with the results of auctions in which 900MHz spectrum is sold alongside 800MHz (which have shown that the price of the latter is not a good estimate of the value of the former) because both can give robust estimates of the market value of 900MHz spectrum. In addition, Ofcom should make changes to the auction rules to remove the opportunity for those not paying ALF to drive up the costs of those that do; in particular the use of competition credits.

In summary, we support much of what Ofcom has done in this second consultation. However, we ask that Ofcom: reconsiders its decision to reserve any spectrum for a fourth operator; includes a technical analysis in its methodologies for assessing the market value of 900MHz spectrum; adjusts the auction rules so that fourth operators cannot artificially drive up the price of 800MHz spectrum.

Vodafone UK
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Introduction and Outline

Vodafone commends Ofcom for the fact that it has taken note of the responses to its previous consultation and made important changes to the analysis and reasoning underpinning its specification of the auction rules. In particular we welcome and endorse Ofcom's recognition that:

- 900MHz spectrum does not provide a short or medium term route to LTE; that HSPA cannot match the performance of LTE in terms of latency, speed, spectral efficiency, prioritisation and capacity and that Vodafone will need to buy spectrum in the auction to provide a route to LTE and to augment the capacity of its network;

- the divested spectrum in the 1800MHz band is an adequate substitute for sub-1GHz spectrum for any potential purchaser;

- it is likely to be the case that, given its existing site portfolio and the development of technologies to deliver better indoor coverage, EE does not need to acquire spectrum in the auction in order to remain competitive. EE is in the best position of all of the existing operators and there is no case for affording EE any special treatment in the auction;

- a national wholesaler could be a credible competitor even though it is not in as strong a position in some dimensions of service or in serving some customer segments as others; it is not the job of the regulator to impose strict egalitarianism on the mobile operators and any competition assessment should be done 'in the round';

- competition analyses of the type that Ofcom has been required to undertake are fraught with uncertainties and there are risks and inefficiencies associated with reserving spectrum for a fourth operator;

- a mechanistic link between auction prices and ALF can create incentives for ALF payers to shade their bids or not to bid at all and;

- the proposed coverage obligation will require a more extensive network build than assumed in the original consultation.

Sections 1 to 3 in this document cover the substantive points that we wish to raise in responding to this consultation.

In section 1 we cover the justification for reserving spectrum for a fourth operator; in particular the likelihood that such an operator will fail to acquire sufficient spectrum because it is out-muscled by the other operators for reasons relating to intrinsic value or 'strategic investment'. We conclude that there is no proportionate case to justify the reservation of <u>any</u> spectrum for a fourth operator. The case is egregiously indefensible when we consider only the 2.6GHz band and the lessons from

auctions in the rest of Europe. These show that when smaller operators want 2.6GHz spectrum they acquire it; that they are never the victims of strategic investment and, in some cases, that they don't even think that they need spectrum in this band. The latter is unsurprising. A simple technical analysis shows that an operator today facing congested sites and growth in data demand of over 60% per annum for 10 years could easily manage this growth using spectrum in the smaller portfolios.

In section 2 we reconsider Ofcom's proposals for setting ALF in the light of the revised competition assessment. We consider that there is now an even stronger case for including a technical and cost analysis in the list of methodologies to be used to set ALF in the post-auction consultation. We also express our concern that proposed auction rules allow any 'fourth operator' to inflate the burden of the ALF on others at no cost to itself. We propose methods to deal with this problem.

Other points are covered in our response to the specific questions in Section 3.

Section 1: Intrinsic values and Strategic Bidding

1. In this section we examine the underpinnings of Ofcom's case for reserving spectrum for a fourth operator: lower intrinsic valuations and the risk of strategic investment on the part of the larger operators. We also examine— as Ofcom does in its consultation — what can be learnt from auctions in the rest of Europe and comment on the addendum to the second consultation published on the 17th of February. We use H3G as our example of a fourth operator because Ofcom's main concern (and its corresponding remedy) is to prevent the mobile market reducing from four to three 'national wholesalers', which requires the foreclosure of H3G through its failure to acquire sufficient spectrum.

2. We find that there is no case for reserving spectrum for H3G. If H3G needs the spectrum to survive, then its valuation will exceed that of those that do not. Strategic bidding is too fraught with uncertainty and too ruinously expensive (we estimate that it could amount to between [Confidential]. in *additional cost*) to make it a credible risk.

Intrinsic Values

3. Where additional spectrum to support the roll out of LTE is necessary for H3G to be a credible national wholesaler, there is no reason to believe that H3G has a relatively low or a lower intrinsic value than the other national wholesalers.

4. H3G's only existing paired mobile spectrum is 2x15MHz at 2.1GHz, and so it has no early route to LTE and only a limited share of the total spectrum that will be available after the auction. Ofcom recognises that, everything else equal, H3G should therefore have a high intrinsic value for additional spectrum. Moreover, Ofcom acknowledges that, if sub-1GHz spectrum were necessary for H3G to be a credible national wholesaler in the future, then H3G would be expected to have a correspondingly high valuation for sub-1GHz spectrum (paragraph 5.82 of Annex 6).

5. Ofcom assumes that the benefits brought by a relatively small amount of additional spectrum are materially different for H3G, in that this spectrum is *required* for H3G to launch LTE, whereas for the other national wholesalers, incremental spectrum either reduces the costs of the LTE network that they would roll out in any case, or would allow them to launch LTE services more quickly. Under Ofcom's assumption, namely that the availability of an LTE network is critical to H3G's revenues in the long run, H3G's intrinsic value is likely to be much greater than the other national wholesalers. There

is therefore a significant contradiction between: (i) Ofcom's critical assumption for justifying its intervention in favour of H3G that, absent access to additional spectrum, H3G would not be a credible competitor; and (ii) Ofcom's view that H3G is likely to have a lower intrinsic value than the other national wholesalers.

6. Ofcom attempts to square this circle by arguing that H3G's smaller existing customer base is likely to reduce its intrinsic value relative to the other national wholesalers. We believe that this does not withstand close scrutiny because:

   a. H3G will be using the spectrum to deploy LTE and support new 4G services;

   b. there is a level playing field between H3G and the other national wholesalers in the provision of services to the subscribers most likely to be early adopters of 4G;

   c. the fact that Vodafone, Telefonica and EE have larger installed bases of existing (primarily 2G) customers does not provide them with a competitive advantage over H3G in competing for those subscribers that are attracted by 4G services, as it is not realistic to expect that a significant proportion of subscribers to 2G services would be 'early adopters' of 4G services;

   d. an existing customer base of 3G subscribers and data users is arguably more relevant to attracting 'early adopters' of 4G services. H3G is not disadvantaged in this respect. Ofcom's analysis shows that H3G is in a strong position in the provision of 3G services, with 5.6m subscribers, [Confidential]. Moreover, Ofcom's assessment indicates that H3G is particularly strong in the provision of dongles - it is the market leader in this segment, with a 52% share;

   e. Ofcom is incorrect to suggest that evidence on experience with take up of 3G services is consistent with an existing customer base of voice users being important. In any case, H3G is now an experienced provider of mobile services, unlike in the early period after the launch of 3G services.

   f. If the 2x15MHz of 1800MHz spectrum is included in the auction then it cannot be credible to suggest that either Vodafone's or Telefonica's incremental intrinsic valuation of this block *over and above 800MHz* exceeds H3G's intrinsic valuation of this spectrum *alone*.

7. Given the above, there is no reason to expect that H3G's intrinsic valuation of spectrum is lower than its rivals. Moreover, there is a contradiction at the heart of Ofcom's analysis which it has failed

either to acknowledge properly or resolve. If additional spectrum is critical for H3G's future then the intrinsic value that it places on that spectrum must be greater than others who either do not require the spectrum (EE) or may only require it at some point in the future (Vodafone and Telefonica). H3G will 'bet its farm' (up to the value of that farm) to secure its future and there is therefore no need to reserve spectrum.[1,2]

Strategic investment

The cost of strategic investment

8. Strategic bidding has the intent of changing who acquires the spectrum such that it is not acquired by the user with the highest intrinsic value. Strategic bidding will by definition result in an increase in the price paid at auction compared with the counterfactual of bidding solely based on intrinsic values:

    - In the simplest case of strategic bidding, an operator with a lower intrinsic value (operator A) will attempt to outbid an operator with a higher intrinsic value (operator B). In this case the price paid will be the intrinsic value of the operator excluded if the strategic bidding is successful. If strategic bidding is not successful the auction price will be the bid ceiling of operator A (a premium above the intrinsic value which is not sufficiently high to outbid operator B even if it was expected to be);

    - Absent strategic bidding the operator with the higher intrinsic value (operator B) will be successful with the price paid being the intrinsic value of operator A.

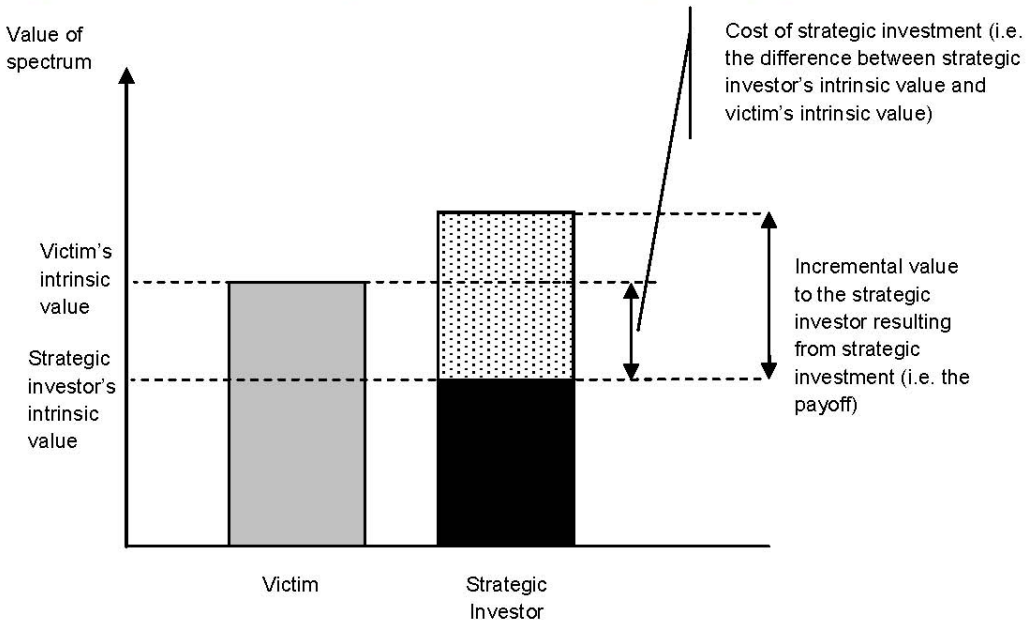
9. It is clear that there is a direct cost of strategic bidding to operator A in the case that strategic bidding is successful, as a premium will be

[1] Ofcom acknowledges, "… if sub-1GHz spectrum were necessary for H3G to be a credible national wholesaler in the future we would expect H3G to have a correspondingly high valuation for sub-1GHz spectrum that reflects this" (paragraph 5.82 of Annex 6).

[2] Ofcom's illustrative example of the potential retail price increases that would be required in order to justify the costs of strategic investment to render a fourth operator 'non-credible' (paragraphs 5.132 to 5.145 of Annex 6) is consistent with an interpretation of the term 'non-credible' as implying that the fourth national wholesaler would not be able to be a viable player in the UK mobile market. Ofcom seems to consider that, in this scenario, absent a block of 2x10MHz of 800MHz spectrum, the fourth national wholesaler would not only be unable to provide 4G services, but would also be unable to compete in the UK mobile market overall – as its subscribers would not consider it a credible provider of mobile services more generally. This interpretation is consistent with the way in which Ofcom 'models' the retail price increases that a strategic investor would have to be able to implement, in order for the benefits of the strategic investment to outweigh the costs (paragraph 5.139 of Annex 6). These price increases are calculated on the basis of average ARPUs across all mobile services – as they are based on an estimate of overall UK mobile market revenues of £15bn (paragraph 5.137 of Annex 6).

paid above its intrinsic value of the spectrum: the premium will be the additional intrinsic value of the spectrum required to outbid operator B. This is illustrated in Ofcom's figure 5.2.

Figure 5.2: Cost of strategic investment and expected payoff



10. Given this, *if* additional 4G spectrum is critical for a national wholesaler to remain credible in the UK market, then the intrinsic value of such spectrum would be up to the total NPV of its future cashflows from its UK business. This can be approximated by estimating the enterprise value of such a wholesaler.

11. An estimate of this value for H3G in the UK can be inferred based on information from Italy. Using recently reported estimates for the value of H3G's Italian business,[3] a realistic estimate of the enterprise value of H3G UK is around £3bn – this provides an estimate of the cost of excluding H3G from the UK market. The estimate of the cost of strategic bidding used by Ofcom in its illustrative example of Scenario A, based on the average price paid in other auctions of 800MHz spectrum (around £290m per 2x5MHz of 800MHz block) is therefore a very material underestimate of the true cost of strategic bidding.

[3] Telecom Italia May Acquire Hutchison's 3 Italia, Corriere Says, Aug 3, 2011: Telecom Italia SpA (TIT), the nation's biggest phone company, may acquire 3 Italia SpA, the local wireless operator owned by Li Ka-shing's Hutchison Whampoa Ltd. (13), Corriere Della Sera reported, without saying where it got the information. Goldman Sachs Group Inc. (GS) and Bank of America Merrill Lynch are working on a merger plan without a formal mandate, the Italian newspaper said today. 3 Italia would be valued at 4.3 billion euros ($6.1 billion) including some tax losses, the report said, citing an estimate by Deutsche Bank AG. (DBK). H3G's subscribers in the UK were approximately 80% of its subscribers in Italy in March 2011 (see Annex 5). We have used an August 2011 exchange rate of 1.14 €/£.

12. Furthermore, the cost of strategic bidding will be even higher because of the proposed link between the prices paid in the forthcoming auction and ALF. Although ALF should be set on the basis of intrinsic values (since these are supposed to be the proxy for the market value of 900MHz spectrum) and so increases in auction prices due to strategic bidding should not be passed through, Ofcom will be unable to identify any part of the auction price that is due to strategic bidding rather than intrinsic value. Thus increases in auction bids due to strategic bidding will be passed through to the ALF. The use of benchmarks from other auctions may dampen the impact somewhat such that the degree of 'pass through' is not 100%, but the extent of any reduction in pass-through is unknown to those contemplating strategic bidding because the precise methodology applied will only be known after the auction. Our calculations in this section therefore represent an upper bound on the cost of strategic investment.

13. EE, Vodafone and Telefonica are the potential strategic bidders and are all holders of spectrum on which ALF payments are to be levied and so would be affected by increased ALF charges. For Telefonica and Vodafone any increases in either 800MHz or 1800MHz auction prices would be expected to feed through to increased ALF charges for 900MHz and 1800MHz spectrum respectively.

14. Whilst EE would only be affected by increases in 1800MHz ALF charges, and cannot bid (strategically or otherwise) on 1800MHz spectrum, switching behaviour by bidders means that any increase in prices for 800MHz spectrum could be expected to increase the price paid for 1800MHz spectrum. Thus EE bidding strategically for 800MHz spectrum could impose an additional indirect cost on itself. Similarly, to the extent that switching between bands results in an increase in the price of one band where strategic bidding was taking place increasing the auction prices in all bands, strategic bidding by Telefonica or Vodafone on 800MHz or 1800MHz bands alone could result in increases to the ALF for 1800MHz or 900MHz spectrum respectively.

15. EE, Vodafone and Telefonica will take into account the potential indirect impact of strategic bidding on ALF when deciding whether to bid strategically, even if the cost is uncertain. Whilst the degree of pass through is uncertain, there is a significant multiplier effect in place, with the operators holding significantly more spectrum on which ALF is levied than a 2x10MHz block of spectrum.

16. [Confidential].

17. [Confidential].

18. [Confidential].

19. Even if operator A's strategic bidding were unsuccessful because the strategic premium that the operator is willing to pay is less than the difference in intrinsic values, the strategic bidding, by increasing the auction price, will increase ALF charges. Thus even unsuccessful strategic bidding will have a cost.

20. In summary, Ofcom has materially under-estimated the cost of strategic investment, because: (a) the direct cost would be orders of magnitude larger than assumed by Ofcom under Ofcom's assumption that H3G would not be a credible/viable competitor if excluded from 4G spectrum; and (b) the cost would be increased significantly through the indirect cost of higher ALFs.

The pay-off from strategic investment

21. Given the very significant cost of engaging in strategic bidding for any of the larger national wholesalers, the only way for such bidding to be attractive would be if the pay-off, in terms of the benefits of less intense competition, outweighed such costs.

22. Ofcom considers that the payoff of successful strategic investment could be significant since if the number of national wholesalers were to fall from four to three, then this would lead to a material reduction in competition in the UK market. Ofcom states that its assessment is based on treating this outcome as if it were analogous to a merger situation, and applying the tools of merger analysis to understand the effect on competition. However, Ofcom has failed to apply the tools of merger analysis correctly, and so its conclusions are purely speculative.

23. Ofcom concludes that "[o]ther things equal, especially in a market with significant barriers to entry, competitive intensity in a market will tend to be higher where there are more competitors and lower where there are fewer competitors" (paragraphs 240 and 2.63 of Annex 6 of Ofcom's second consultation). However, it is widely recognised by competition authorities that not all mergers in concentrated markets lead to a reduction in competition, and that a case-by-case analysis is required. Whether or not a four to three merger would lead to a reduction in competition depends on a number of features of the market in question and the way that competition takes place. Unfortunately, Ofcom's assessment of competitive effects in the UK mobile market is partial and misses salient features of the market (as revealed by Ofcom's use of the phrase "… other things equal ...").

24. Competition authorities assessing mergers in a concentrated market typically take into account a much richer set of considerations.[4] In particular, Ofcom has not adequately assessed the two key theories of harm that competition authorities explore when assessing mergers in concentrated markets:

a. Unilateral effects: Ofcom's second consultation does not recognise that in markets with homogenous products and without capacity constraints, it would be incorrect to conclude that there is a simple relationship between concentration and competition. In these circumstances, economic theory predicts that two firms are enough to keep prices at their competitive level, and that a merger from four to three firms would not be expected to lead to unilateral effects concerns. Ofcom has not explored the extent to which the products and services of the various national wholesalers in the UK market are differentiated, or whether there are material capacity constraints that would prevent certain national wholesalers from expanding output. Indeed, there are reasons to believe that neither of these features characterise the wholesalers of mobile services in the UK, and so that Ofcom's conclusions regarding unilateral effects are incorrect.

b. Coordinated effects: Ofcom's second consultation mentions a number of potential forms of coordination but fails adequately to establish how any of these could be reached, monitored and sustained – particularly since it recognises that coordination on price at the retail level is unlikely due to lack of transparency. Ofcom suggests the possibility that retail coordination could take place without coordination on prices through either tacit "market-sharing" or though delaying innovation and investment. Yet it does not consider how such agreement could be reached or monitored without coordinating the retail offers, particularly when: i) mobile markets are characterised by high levels of customer churn; and ii) innovation and investment plans are non-transparent and relate to one-off competitive moves that cannot necessarily be punished or reversed. Ofcom invokes the possibility of coordination at the wholesale level to rule out the possibility that retail coordination could be undermined by a competitive fringe of MVNOs. Yet the second consultation contains no discussion of the likelihood of wholesale coordination and therefore fails to consider factors such as the lack of transparency in wholesale negotiations with MVNOs, and

[4] See for instance the European Horizontal Merger Guidelines at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2004:031:0005:0018:EN:PDF and the UK CC/OFT Joint Merger Guidelines at http://www.competition-commission.org.uk/assets/bispartners/competitioncommission/docs/pdf/non-inquiry/rep_pub/rules_and_guide/pdf/100916_merger_assessment_guidelines.pdf.

the absence of frequent repeated interactions in the wholesale market.

25. For these reasons, Ofcom's conclusion that a reduction in national wholesalers from four to three would result in a material reduction in competition cannot be justified. We expand upon these points in Annex 1 and in our legal analysis in Annex 3.

26. Ofcom provides an illustration of the price increases that would make strategic bidding attractive for the three national wholesalers – these are the retail price increases that would be required in order to justify the costs of strategic investment (paragraphs 5.132 to 5.145 of Annex 6). The scenario that Ofcom is seeking to evaluate is *Scenario A - a fourth national wholesaler not credible if it does not acquire at least 2 x 10MHz of 800MHz*. Ofcom considers that, in this scenario, absent a block of 2x10MHz of 800MHz spectrum, the fourth national wholesaler would be unable to compete in the UK mobile market overall – as its subscribers would not consider it a credible provider of mobile services more generally. This interpretation is consistent with Ofcom's overall competition effects analysis and with the way in which Ofcom 'models' the retail price increases that a strategic investor would have to be able to implement, in order for the benefits of the strategic investment to outweigh the costs (paragraph 5.139 of Annex 6). These price increases are calculated on the basis of average ARPUs across all mobile services as they are based on an estimate of overall UK mobile market revenues of £15bn (paragraph 5.137 of Annex 6).

27. [Confidential]..[5]

The feasibility of strategic investment

28. Ofcom believes that there is a material risk that the larger national wholesalers would have an incentive to engage in strategic investment to exclude H3G from obtaining the additional spectrum that it would need in order to be a credible competitor. In particular, Ofcom considers two possible situations: (1) where the benefits to each large national wholesaler (or at least one of the operators) exceed the total costs of exclusion, such that they unilaterally have an incentive to engage in strategic investment; and (2) where the overall benefits to Vodafone, Telefonica and EE combined from the exclusion of H3G exceed the total costs of strategic investment, such that they collectively have an incentive to engage in strategic investment.

[5] As we explain in Annexes 1 and 3 it is not possible to conclude, taking into account the current market conditions, that it would be possible for strategic winners to tacitly collude over pricing in the retail mobile market. In other words: the payoff from strategic investment illusory.

29. Vodafone believes that, in both cases, spectrum caps, uncertainty about others' valuations and the potentially exorbitant cost mean that the risk of strategic investment is negligible and the reservation of spectrum for a fourth operator is therefore disproportionate. We tackle the two cases in turn.

Unilateral strategic investment

30. Ofcom appears to consider that if the pay-off for an individual national wholesaler from strategic bidding exceeds the associated costs, then strategic investment by that operator is feasible and so likely to take place. This is misconceived. The only way that an individual national wholesaler could *unilaterally* ensure that a fourth operator is excluded, without co-ordination with the other larger national wholesalers and knowledge of their intrinsic values, is by acquiring so much of the spectrum in the sub-1GHz band[6] that this operator is unable to be a credible competitor. This is not possible under the rules of the auction. Even if a strategy of excluding a fourth operator were unilaterally attractive for the larger national wholesalers, such a strategy could not be implemented unilaterally.

31. This can be illustrated through a simple example using Ofcom's Scenario A. Assume that Vodafone has a lower intrinsic value than (say) H3G, and that the (intrinsic plus) strategic value for Vodafone is higher than the intrinsic value of H3G. In this scenario, Vodafone would have a unilateral incentive to engage in strategic bidding to exclude H3G. However, under Ofcom's auction rules, where each bidder is unaware of the identity of the other bidders, absent coordination, Vodafone would need to acquire at least five 2x5MHz blocks of 800MHz of spectrum to be certain that it has excluded H3G. This is not permitted under the spectrum cap rules.

32. The same logic applies to the example that Ofcom uses in relation to Scenario A, where it argues that strategic investment may be feasible even if the intrinsic values for the larger national wholesalers were to differ. The specific example used by Ofcom is one where EE places a higher intrinsic value on a 2x10MHz block of 800MHz spectrum than H3G; Vodafone and Telefonica are assumed each to have lower intrinsic values than H3G, and the (intrinsic plus) strategic value for (each of) Vodafone and Telefonica is higher than the intrinsic value of H3G. In this scenario, Vodafone and Telefonica could each have a unilateral incentive to engage in strategic behaviour to exclude H3G. However, it does not follow that it would be feasible for Vodafone or Telefonica unilaterally to prevent H3G from acquiring a 2x10MHz block of 800MHz spectrum. Knowing that EE valued the spectrum more than H3G would imply that, absent coordination, Vodafone would need to buy at least 2x15MHz of 800MHz spectrum to ensure

[6] Or 'sub-2GHz bands' if the 1800MHz spectrum is included in the auction.

that H3G is excluded. This is not possible under the rules of the auction. The same would apply to Telefonica.

33. The only situation in which it would be both desirable and feasible under the auction rules for a larger national wholesaler unilaterally to engage in strategic investment would be if it were certain that the other two larger national wholesalers each had higher intrinsic values than H3G for a 2x10MHz block of 800MHz spectrum, and it had a lower intrinsic value than H3G. We consider this to be extremely unlikely; there is no way that, absent coordination, an individual bidder can know this with any degree of certainty and without this knowledge a strategy of strategic investment is folly.

Co-ordinated strategic investment

34. Exclusion of H3G is only possible if all three large operators were prepared to pay above H3G's intrinsic value for the 800MHz spectrum and – in Scenario B – at least Vodafone or Telefonica were prepared to pay above H3G's intrinsic value for the 1800MHz spectrum. However, even if all of the large national wholesalers were to hold such high strategic valuations (which is highly unlikely) this by itself would not necessarily lead to exclusion as an outcome. It would still require the larger operators to coordinate their behaviour in the auction, since exclusion only succeeds if all three larger operators bid strategically. If any one of the bidders does not bid strategically, then exclusion will fail and this means that other operators will also no longer be prepared to pay the strategic 'premium' above their intrinsic valuations. In this situation, the larger operators therefore need to solve a coordination problem in order to achieve exclusion – each would rather bid strategically if all others do so, whereas all would prefer not to bid strategically if any one of them will not bid strategically.

35. In Scenario A, Ofcom is concerned that the three larger operators could use an exclusionary strategy of each acquiring of 2x10MHz of 800MHz spectrum. There are two alternative sets of bidding strategies ('exclusion' and 'non-exclusion') both of which potentially represent an equilibrium:

    a. Each of the large operators stays in the 800MHz auction until they acquire one block of 2x10MHz of 800MHz spectrum (at which point they will pay H3G's intrinsic value); or

    b. Each of the large operators bids up to their intrinsic valuation only.

36. Both of these strategies are rational, provided that all of the operators each believe that the others are following the same strategy. In this

example, there is no prima-facie reason to rule out either strategy as a possible outcome.

37. Ofcom considers that an exclusionary outcome is likely since there is a natural focal point for coordination, i.e., that the larger national wholesalers each acquire one 2x10MHz block of 800MHz spectrum. However, it would be incorrect to assume that strategy (a) 'exclusion' is the more likely outcome simply because it results in higher aggregate payoffs for the larger operators. In fact, outcome (b) 'non-exclusion' is more likely because it does not rely on coordinated behaviour. An operator that follows strategy (b) knows that the outcome will be roughly the same regardless of what other operators choose to do: they will obtain a 2x10MHz block of 800MHz spectrum for at or below their intrinsic value. In contrast, following the coordinated strategy (a) is much more risky. It only succeeds if each of the large national wholesalers chooses the same strategy, and it is potentially very costly if it fails – with operators paying far above their intrinsic valuations.

38. The circumstances that would support strategy (a) as an outcome are very unlikely to eventuate in practice. The larger operators will choose this strategy only if:

    a. they each independently reach the view that their strategic valuation exceeds H3G's intrinsic value;

    b. they each independently reach the view that both of the other large operators' strategic valuations will exceed H3G's intrinsic value; and

    c. they each independently reach the view that the other large operators will have arrived at similar judgments (both in relation to their own valuations, and in their estimates of the others' valuations).

39. Thus, in the presence of even a small amount of uncertainty about the valuation of any player in the auction, the strategic outcome (a) is unlikely to happen. A concrete example of this is as follows:

40. Vodafone estimates that its and Telefonica's (intrinsic plus) strategic values are higher than H3G's intrinsic value;

    a. Vodafone then estimates that EE's (intrinsic plus) strategic valuation is lower than H3G's intrinsic valuation (this is quite plausible given Ofcom's view that EE probably doesn't need any more spectrum);

b. Vodafone therefore believes that EE will not be prepared to bid strategically in the auction, and will drop out when the price reaches EE's intrinsic value;

d. Vodafone infers that H3G will succeed in obtaining a 2x10MHz block of 800MHz spectrum (even if it and Telefonica were to bid strategically) and therefore H3G will not be excluded;

e. Vodafone will not therefore be prepared to bid strategically, and will drop out of the auction when the price exceeds its intrinsic valuation;

f. H3G will succeed in acquiring a 2x10MHz block of 800 MHz spectrum.

41. Or alternatively, consider the example where:

a. Vodafone estimates that all three larger operators have (intrinsic plus) strategic valuations higher than H3G's intrinsic valuation;

b. however, Vodafone takes the view that EE's thinking is in line with the logic set out in the example above, i.e., that EE estimates that Vodafone's and/or Telefonica's (intrinsic plus) strategic valuation is lower than H3G's intrinsic valuation;

c. Vodafone therefore reasons that even though EE has a high (intrinsic plus) strategic value, EE is sufficiently unsure about Vodafone's valuation, such that EE will not be prepared to bid strategically;

d. Vodafone will therefore anticipate that EE will not bid strategically, and so Vodafone itself will also drop out of the auction when the price reaches its intrinsic value.

42. These examples illustrate the difficulty of arriving at a coordinated outcome when there is even a small amount of uncertainty. Each MNO will default to the 'safe' option of bidding non-strategically whenever they consider that the risk of coordination failing is sufficiently high.[7] We consider this observation to be highly relevant to the present situation. The different starting positions of the three larger national wholesalers, in terms of their respective spectrum holdings and market shares, create significant difficulties in being able to arrive with any degree of certainty at a view about the intrinsic and strategic values of the other larger operators.

[7] In game theoretic terms, non-strategic bidding is the "risk dominant" equilibrium. The economic literature on coordination games predicts that, in the presence of uncertainty about how others will behave, it is the risk dominant Nash equilibrium that will emerge. For example see Young, *"The Evolution of Conventions"*, Econometrica, 61, 1993.

43. In Scenario B, where the larger operators would need to secure 1800MHz spectrum as well as 800MHz spectrum in order to achieve exclusion, successful coordination would be even harder to achieve. In addition to the conditions set out above, it would need to be the case that all the larger operators believed that at least Vodafone or Telefonica would also be prepared to bid strategically for the 1800MHz spectrum – requiring a strategic valuation large enough to be able to afford to overpay for both 800MHz and 1800MHz spectrum. And, if both Vodafone and Telefonica were to have the incentive to overpay for both 800MHz and 1800MHz spectrum, then Vodafone and Telefonica would also face a coordination problem. Only one would need to over-bid in order to exclude H3G, yet both would prefer that it was the other. This raises the further uncertainty that both would leave strategic bidding for 1800MHz spectrum to the other – and so neither would succeed in excluding H3G from the auction.

44. The low risk, non-strategic, outcome becomes more likely to prevail when the size of the potential losses from failing to coordinate are large relative to the 'prize' of successful coordination. This will be the case whenever:

    a. the difference between H3G's intrinsic value and the intrinsic value of the other players is large (since this would be the cost of bidding strategically when coordination ultimately failed); and

    b. the difference between H3G's intrinsic value and the other players' (intrinsic plus) strategic values is small (since this is the potential prize associated with successful coordination).

45. For the reasons set out in the previous sections, both of these conditions are likely to hold, because H3G's intrinsic valuation (in the face of potential exclusion from the market) is relatively high. [Confidential].

<u>Side payments between operators</u>

46. Ofcom considers that an exclusionary outcome is possible/probable since there is a natural focal point for coordination, i.e. that the larger national wholesalers each acquire one 2x10MHz block of 800MHz spectrum. However, such a strategy may not be feasible under Ofcom's auction format without side payments between the larger national wholesalers. This is obviously not permitted.

47. We imagine that Ofcom has the following situation in mind under Scenario A.

Value for 1 block of 2x10MHz of 800MHz	Intrinsic value (IV)	Strategic value (SV)	IV+SV
Vodafone	900	101	1001
Telefonica	900	101	1001
EE	900	101	1001
H3G	1000		1000

48. In this scenario, if the larger national wholesalers were each to acquire one 2x10MHz block of 800MHz spectrum, then they would each incur a cost of 100 in excluding H3G – which would be worthwhile as they would each benefit 101 from excluding H3G.

49. However, if the intrinsic values for the larger national wholesalers were to differ, then this would no longer necessarily be the case. Consider, for example, the following situation. In this case, if the larger national wholesalers were each to acquire one 2x10MHz block of 800MHz spectrum, then the costs of excluding H3G would be 50 for Vodafone and Telefonica and 200 for EE, whilst the benefit would be 101 to each operator. The implementation of an exclusionary strategy would then require that EE pays more than its (intrinsic plus) strategic value to exclude H3G, which it would not be prepared to do unless it were compensated by Vodafone and Telefonica. This example illustrates that where their intrinsic values differ, the implementation of an exclusionary strategy may not only require the use of a focal point, but also some form of side-payments between the larger operators.

Value for 1 block of 2 x 10MHz of 800MHz	Intrinsic value (IV)	Strategic value (SV)	IV+SV
Vodafone	950	101	1051
Telefonica	950	101	1051
EE	800	101	901
H3G	1000		1000

Lessons from other auctions

50. In paragraph 3.2 of the Revised Competition Assessment, Ofcom states that "[a] national wholesaler is likely to need sufficient spectrum in order to serve enough customers with sufficiently high average data rates. We consider that there is some risk that a

national wholesaler would not have enough capacity to be credible if it held less than 10-15% of total spectrum holdings". This observation, alongside the concerns that a fourth operator may fail to acquire spectrum because of a lower 'intrinsic value' for the spectrum or as a victim of strategic investment, is instrumental in the specification of the medium portfolios.

51. Ofcom does admit in 3.63 of the same document that "…it is not necessarily the case that a national wholesaler with less than 10% of available spectrum cannot act as a credible national wholesaler". Nevertheless, it is worth considering whether an analysis of auctions in Europe supports the need to reserve spectrum for a fourth operator and whether they can say anything about the amount of spectrum that should be reserved.

52. Ofcom includes a helpful annex on spectrum auctions and the distribution of spectrum holdings in Europe and elsewhere which it uses to substantiate its belief that a fourth/smaller operator needs 10-15% of the available spectrum in order to be credible. We summarise some of the details of the 2.6GHz auctions and the expected future percentage holdings of spectrum for the smallest operators in relevant markets in the table below. In the last column of the table we indicate whether the smallest operator could have been rendered uncompetitive by virtue of strategic investment on the part of the other larger operators in the auction i.e., driven below Ofcom's minimum spectrum share requirement (10-15%).

Country	**Operator**	**Paired 2.6GHz**	**Minimum expected future share of spectrum**[8]	**Uncompetitive national wholesaler without paired 2.6GHz**
Austria	H3G	20MHz	13%	Yes
Belgium	Telenet Tecteo	-	12%	n/a
Denmark	H3G	10MHz	15%	Yes
France	Illiad	20MHz	11%	Yes
Germany	Telefonica	20MHz	24%	No
Germany	E-Plus	10MHz	25%	No
Italy	3 Italia	10MHz	12%	Yes
Netherlands	Tele2	20MHz	11/13%	No
Netherlands	Ziggo	20MHz	11/13%	No
Spain	Yoigo	-	11%	n/a
Sweden	H3G	10MHz	17%	No

[8] From Ofcom's figure 3.7 in Annex 6

53. From this simple analysis we can make a number of important observations:

    a. In all of the auctions, apart from those in Belgium and Spain, the smallest operator acquired at least 2x10MHz of paired 2.6GHz spectrum, typically without the need for a reservation of spectrum for the acquiring party.[9]

    b. In Belgium, Telenet Tecteo Bidco has 2x15MHz of 2.1GHz spectrum and is expected to exercise an option to acquire 2x15MHz of sub 2.1GHz spectrum. In Spain, Yoigo has 2x15MHz of 2.1GHz spectrum and 2x15MHz of 1800MHz. It appears that both operators believe that they do not require 2.6GHz on top of their other holdings in order to be a credible competitor; the relatively low price of 2.6GHz spectrum £0.04MHz/pop or less than £50m for 2x10MHz – would suggest that budget constraints were not an issue.[10]

    c. In auctions where strategic bidding could have reduced the smallest operator to a portfolio with insufficient spectrum to be a viable national wholesale operator (by Ofcom's reasoning) this has not occurred.

54. From these observations we can draw a number of inferences:

    a. There is no need to reserve 2.6GHz spectrum since any operator who wants it enough to bid for it can be assumed to win at least 2x10MHz.

    b. There is no evidence of strategic investment on the part of incumbent operators, even in auctions where the design has made this more of a risk i.e., by allowing bidders to see or infer who is bidding for what. No small operator has been driven below the minimum amount of spectrum required for capacity purposes (by Ofcom's analysis) as a consequence of strategic bidding.

    c. There is evidence from Belgium and Spain that the smaller portfolios provide enough spectrum for a fourth operator. Neither Yoigo nor Telenet Tecteo Bidco bid for any spectrum in the 2.6GHz band so they *voluntarily* accepted less than Ofcom's proposed floor for the fourth operator. Similarly, in Italy, Hutchison Whampoa's Group Managing Director has stated that 3 Italia will be able to achieve "comparable performance" to the

[9] We accept that in the Netherlands the existing operators were subject to caps in the 2,6GHz auction.

[10] Ofcom acknowledges this in Annex 6:3.63 "…it is not necessarily the case that a national wholesaler with less than 10% of available spectrum cannot act as a credible national wholesaler".

incumbent operators using its recently acquired 1800MHz (2x5MHz) and 2.6GHz (2x10MHz) spectrum[11] i.e., only 2x15MHz of additional spectrum.

d. The risk of making 2x10MHz of 2.6GHz part of a minimum package is that the fourth bidder doesn't actually want it very much, but is forced to take it anyway e.g., in Spain and in Belgium. If each had been asked to "opt in" for a floor involving both 1800MHz and 2.6GHz then we can reasonably assume that each would have done so, since neither would have wanted to compete openly for the 1800MHz or wanted the risk of someone else opting in for the 1800MHz in their place. The reserved spectrum would have meant that both would have ended up with 2.6GHz spectrum without wanting it and therefore depriving another operator who could have put it to better use and would have been willing to pay more to acquire it.

55. Evidence from other markets therefore suggests that Ofcom, if it chooses to reserve spectrum for a fourth operator, should opt for the smaller sub-2GHz portfolios safe in the knowledge that if this operator believes this to be insufficient then it can be assured of acquiring at least 2x10MHz of 2.6GHz spectrum provided it is prepared to pay a market rate.

56. This conclusion is supported by our technical analysis included in Annex 2. We use Ofcom's data to conclude that an operator with 'only' spectrum in the smaller portfolios can provide a credible network in terms of coverage, speed and capacity. We also include a simple example to show that an operator today facing congested sites and growth in data demand of over 60% per annum for 10 years (or over 130 fold) could handle this growth with 2x15MHz of 1800MHz (and 2x10MHz at 800MHz) and a minimal (or easily manageable) additional site rollout over a number of years.

57. We note that our analysis is consistent with the decision by the European Commission in its review of the proposed merger of T-Mobile UK and Orange UK in 2010. The Commission found that 2x15MHz of 1800MHz spectrum was sufficient to create a credible LTE player. In Annex 3 our legal analysis argues that, assuming Ofcom is still minded to reserve spectrum for a fourth operator on the basis that it would fail to acquire sufficient spectrum in the auction, then it would be disproportionate to include 2.6GHz spectrum in any proposed reservation.

[11] Annex 6 paragraph 3.135

The private sale of the 1800MHz spectrum

58. In an addendum to the second consultation published on the 17 February Ofcom asks how it should treat the spectrum portfolios if EE sold the rights to use the 2x15MHz of 1800MHz spectrum that it is required to divest as part of its merger commitments, to a party other than Vodafone or Telefónica. As Ofcom explains in the second paragraph:

> *"It seems to us that the key issue in this situation is whether it would be sufficient to meet our objective of there being at least four credible national wholesalers, that parties other than EE, Telefónica and Vodafone collectively held (at least) the spectrum in one of the spectrum portfolios we have identified, even if they do not do so individually (Case 1); or whether it is necessary to meet our objective that there is at least one party who on its own holds (at least) one of the identified spectrum portfolios (Case 2)."*

59. Our case above is that Ofcom should not reserve any 2.6GHz spectrum for a fourth operator because there is no evidence that those that want it will fail to acquire it. However it seems to Vodafone that the logic of Ofcom's case is that it should be sufficient that parties other than EE, Telefónica and Vodafone *collectively* hold spectrum in one of the portfolios identified by Ofcom. This is best illustrated with a simple example.

60. We assume that there is a fourth (Fo) and a fifth operator (Fi) interested in purchasing sufficient spectrum in the auction. There are a number of permutations to consider:

    a. Fo buys the 1800MHz spectrum pre-auction in a private sale. If Fo then "opts in" for a floor, it has to bid for 2x10MHz of 2.6MHz. If it wins this spectrum then it has sufficient spectrum to compete and the objectives of the auction are met. (If Fo does not opt in for a floor then this would suggest that Ofcom has set the floor too high).

    b. Fi enters the auction and opts in for the floors and manages to outbid Fo.[12] This leaves Fo and Fi with insufficient spectrum (according to Ofcom) *individually* to compete. If Ofcom is right in its analysis then both are left with no option but to cooperate and share the spectrum. If Ofcom is wrong and either or both holdings of spectrum are sufficient (as at least some operators in Europe appear to believe) then there will be no spectrum

[12] We ignore for simplicity Fi outbidding others for the 800MHz band

sharing but competition will not suffer because it will have turned out that Ofcom has exaggerated the holdings of spectrum required by a fourth operator to compete.

61. There is an obvious risk that Ofcom may block any sharing/trading/leasing of spectrum between Fo and Fi. However, this risk must be extremely small[13] given that it would, according to Ofcom, be pro-competitive. First, because Ofcom believes that having "four" national wholesalers with access to sufficient competition is vital for competition. Second, it believes that, on their own neither Fi nor Fo has sufficient spectrum to compete and so, by definition, such spectrum sharing must enhance competition. In fact, as Ofcom notes, such network sharing arrangements could be structured "such that the sharers have an incentive and ability to continue to compete as independent national wholesalers"[14]. It appears therefore that under Case 1 there is no material risk of a reduction in competition, and hence no adverse impact on consumers, from a reduction in the number of credible national wholesalers.

62. There are potentially very high costs associated with Case 2.

63. For example, Fo buys the 1800MHz spectrum but opts not to participate in the auction because it believes that it has sufficient spectrum to compete. Fi will then surely enter the auction and opt for the floors which now must include a large block of 800MHz spectrum at the reserve price. Assuming that there are no other new bidders, Fi is guaranteed that spectrum. However, it may crowd out others who have a higher intrinsic value for the spectrum. As Ofcom notes, "[t]he bidder with the highest intrinsic value will expect to generate most profits from the spectrum which, if the degree of competition in the market remains unaffected, is likely to mean that it delivers the most benefits to consumers".

64. In Case 2, Ofcom would also need to be wary of trading between Fi and Fo post auction. If Ofcom were minded to allow such arrangements, then the combined entity would have obtained an artificially large amount of spectrum at the reserve prices, purely by clever use of the floors.

65. Ofcom will not be required to wrestle with this problem if it follows Vodafone's submission and restricts any reservation of spectrum to the smaller portfolios. Failing that, we believe that to be consistent with its own position, it should favour Case 1.

[13] In fact small enough so as not to have a material impact on each parties' bidding
[14] Annex 6: 2.24

Summary

66. Vodafone submits that there is no substantive case for reserving **any** spectrum for a fourth operator. An existing fourth operator is bound to have an intrinsic value for the spectrum that it requires higher than at least one of the three largest operator especially given that Ofcom has concluded that EE's existing spectrum holdings "are likely to be sufficient for it to be a credible national wholesaler in the future **even if it wins no additional spectrum in the auction**" (paragraph 4.29 our emphasis). Moreover, the conflation of the need to acquire spectrum to survive and the impact of the price of the 800MHz spectrum on the ALF for 900MHz spectrum means that a policy of strategic investment would be ruinously expensive for any single operator and would never be contemplated.

67. Even if Ofcom could, hypothetically, manage to justify earmarking spectrum for a new operator then it would be disproportionate if this reservation went beyond the smaller portfolios. Experience from elsewhere, together with our own technical analysis, casts serious doubt on whether smaller operators actually need 2.6GHz spectrum. Where smaller operators do require 2.6GHz spectrum, they are able to acquire it, despite the potential payoff to strategic investment on the part of other bidders.

68. Restricting any spectrum reservation to the smaller portfolios obviates the need to consider whether spectrum portfolios apply collectively or individually. Failing this, the logic of Ofcom's case is that they should apply collectively: smaller operators who 'split' a minimum portfolio must get together because both will need to do so in order to survive. Ofcom, by its own competition analysis, must sanction such an arrangement in order to preserve competition. If either can compete effectively without the other, then all this demonstrates is that the medium spectrum portfolios are too generous.

Section 2: Annual Licence Fees (ALF) for 900MHz and 1800MHz spectrum

69. The current proposals for annual licence fees lack sufficient clarity for operators to be able to make well informed bids in the forthcoming auction or in any private sale of the 1800MHz spectrum. For example, in respect of the latter, using other auctions in Europe cited by Ofcom as a benchmark, it appears that the present value of the ALF could be between [Confidential]; or higher if the UK auction is an outlier. We suggest that it is unlikely that any bidder would contemplate purchasing the divested spectrum under such uncertain conditions.

70. Moreover, Vodafone remains extremely concerned with the proposed methodologies for setting the annual licence fees after the auction even though the precise calculations will be subject to further consultation. Our concerns relate to three main areas:[15]

    a. Ofcom is wrong to assume that the amounts paid for 800MHz spectrum provide a reliable indicator of the 'full market value' 900MHz: the consultation is littered with reasons as to why this cannot be the case;

    b. even if 800MHz spectrum were an accurate proxy for 900MHz, there is still a risk of distortion in the auction through bid shading if Ofcom uses the amounts paid for spectrum and/or its new Additional Spectrum Methodology to set the ALF;

    c. furthermore, the imposition of a minimum spectrum portfolio for a fourth operator and the proposed method for calculating the ALF gives a fourth operator the opportunity artificially to drive up the price of spectrum – and therefore the cost of licence fees – to penalise its competitors. This has nothing to do with either their intrinsic valuation of the 800MHz band or the market value of 900MHz spectrum and it should make Ofcom extremely wary about the use of the former to determine the latter.

71. Ofcom therefore needs a better methodology which is immune from the deficiencies listed above. Fortunately, Ofcom has one: the tried and tested technical analysis which estimates the opportunity cost (i.e., value) of spectrum. Ofcom has had sufficient confidence in such methodologies to employ them in the past (and to propose employing

[15] We believe that these deficiencies are so material that Ofcom should put little weight on the results of the auction in calculating ALF. Although the Direction from Government requires Ofcom to have 'particular regard to the sums paid at Auction' it can only implement this requirement in a way that is compatible with its statutory duties governing the management of spectrum (see Annex 3).

them in the future) to set licence fees and it has sufficient time to do the necessary analysis ahead of the post auction consultation on ALF. We believe that Ofcom can supplement this approach by using examples from other auctions where 900MHz spectrum is sold alongside 800MHz.

72. In addition to the inclusion of the technical methodology in the ALF calculations, we suggest a number of changes in the auction rules, in particular the use of competition credits, to mitigate this risk that others seek to inflate artificially the price of spectrum and the ALF.

73. It is critical to Vodafone that the deficiencies that we have identified in the way ALF is to be calculated are addressed so that we can participate fully in the auction.

74. In the sub-sections that follow, we explain fully the deficiencies outlined above with the proposed methodologies and detail why we believe that it is appropriate for Ofcom to use the technical methodology to estimate ALF on 900 and 1800MHz spectrum.

Using 800MHz spectrum to value 900MHz spectrum

75. In the previous consultation, Ofcom assumed that Vodafone (and O2) had a near-term route to providing an LTE network by using its existing holding of sub-1GHz spectrum. It was this supposition that lay behind the 2x15MHz spectrum floor which disqualified Vodafone and O2 from 'guaranteed' spectrum in the auction. In other words neither Vodafone nor O2 needed to buy spectrum in the auction to be a viable national wholesaler after the auction because 900MHz spectrum is a substitute for the 800MHz spectrum available in 2013/14.[16]

76. Indeed holding such a large amount of sub-1GHz spectrum would give the 900MHz operators an 'unmatchable competitive advantage' which both would seek to preserve through bidding strategically in the auction. It is this line of reasoning which underpinned Ofcom's decision to use the per MHz price of 800MHz spectrum as a proxy for the 'full market value' of 900MHz spectrum (ignoring any potential consequences for the efficiency of the auction). For example, in paragraph A13.49 in reference to the March 2011 consultation Ofcom says that:

> *"..we considered that bids in the UK auction of the 800 MHz and 2.6 GHz bands would be a particularly useful source of information for estimating the full market value*

[16] See for example in annex 6 paragraph 5.71 Ofcom states that it "expect(s) the 800MHz to be used for LTE as soon as it is available" and then in the subsequent paragraph that it "considers that the 800MHz and the 900MHz are broadly equivalent and we treat them the same in our analysis"

*of the 900 MHz and 1800 MHz bands if the auction was sufficiently competitive. This was because the bands were **generally substitutes**."* (our emphasis)

77. However, Vodafone submits that the evidence and commentary in the current consultation demonstrates that 900MHz spectrum is **not a good substitute** for 800MHz spectrum; at least in the medium term. The reasons for this fall into three areas: the relative performance of HSPA versus LTE; the timing of LTE900 and the standardisation of LTE900:

    a. the performance of HSPA on 900MHz (Ofcom believes that both Vodafone and O2 will be able to run HSPA on 2x10MHz of 900MHz spectrum by 2016[17] i.e., 2 years later than its assumed launch of LTE) is inferior to that of LTE in terms of capacity, spectral efficiency, wider bandwidths and peak data rates[18] and;

    b. Ofcom notes that "the precise timings for when LTE will be deployed using 900MHz are very uncertain"[19] and "today LTE900 is some way behind LTE1800"[20] (and LTE800). LTE will not be deployed in the 900MHz band until some years later than either 1800MHz or 800MHz. Importantly, "the market for LTE devices is international and the extent to which **900MHz operators in the UK alone** can drive the development of an LTE900 ecosystem may be limited" (paragraph 3.204 and our emphasis). This uncertainty is reflected in Ofcom's graphical depiction in Figure 3.15 of Annex 6 of the indicative timescales for the deployment of LTE in different bands which appears to show the potential deployment of LTE900 around 5 years later than LTE800 and 6 years later than LTE1800. These timings may even be extended in the UK because Ofcom is proposing to give EE a head start of more than a year in the provision of LTE.[21]

    c. Ofcom recognises that "…the standards currently do not allow 2x15MHz contiguous blocks to be deployed with LTE at 900MHz, reducing the peak data rates that could be used with 900MHz…we accept that there is some risk that the standards may not allow high peak speeds to be delivered with 900MHz spectrum".

[17] Vodafone (and O2) may therefore be at a particular disadvantage in the early years of LTE (when network reputations are established) because its 2x5MHz on HSPA will need to compete with an operator running 2x10MHz (or greater) on LTE.
[18] realwireless The timing of the consumer and operator features available from HSPA and LTE
[19] 3.203
[20] 3.203
[21] See Notice of proposed variation of Everything Everywhere's 1800MHz spectrum licences to allow use of LTE and WiMax technologies.

78. The evidence therefore suggests that 900MHz spectrum is not a good substitute for 800MHz until towards the end of the decade. Indeed Ofcom now concedes that Vodafone and O2 are likely to need to acquire additional spectrum in the auction – to provide additional capacity and a route to provide LTE – in order to remain competitive in the future.[22] There is therefore no good reason to believe that the price per MHz of 800MHz realised in the auction will provide an accurate estimate of the full market value of 900MHz spectrum.

79. We note that Ofcom's commentary on the discrepancies between the timing of LTE900 versus other bands and the relative performance of LTE versus HSPA accord with the supplementary evidence submitted by Vodafone to Ofcom. In our submission we noted that:

    a. Vodafone expects widespread deployment of LTE at 800MHz, 1800MHz and 2.6GHz between 2011 and 2014.

    b. [Confidential].

    c. Vodafone would not be able to clear 2x10MHz of 900MHz spectrum to run dual carrier HSPA+ until around [Confidential].

80. The available evidence therefore suggests that an operator with only 900MHz spectrum will be at a considerable technical disadvantage to an operator holding either 800MHz or 1800MHz spectrum and that this disadvantage cannot simply be overcome by, for example, accelerating the clearance of the 900MHz band to run HSPA+. The technical characteristics of the two bands (800MHz and 900MHz) are therefore are not "highly comparable" as Ofcom claimed in the original consultation.[23]

81. Ofcom is right to point out that the "extent to which the technical advantages associated with particular spectrum holdings are likely to translate into competitive disadvantages" cannot be accurately predicted.[24] Nevertheless, the existing evidence suggests that speed and capacity matter to customers.

82. Ofcom's cites the Mobile Broadband Research carried out for the Ofcom Consumer Experience survey 2010 which found that a slow connection data rate was the most cited problem when accessing the internet via a dongle or mobile phone, both at and away from home. For example, around one-third (34%) of laptop/dongle out-of-home

[22] See paragraph 4.44 in Annex 6: "On balance we consider that Telefonica's existing holdings are likely to be sufficient for it to be credible in the near term, for at least as long as HSPA900 is competitive with LTE. But there is some potential risk of it not being credible in the longer term if LTE900 equipment is not available soon thereafter, or because of the relatively limited overall spectrum share it will hold if it did not win spectrum in the auction".
[23] 10.13
[24] 3.10

users cited a slow download data rate as the main cause of dissatisfaction. Other independent market research indicates that customers care about speed.[25]

83. Because the current holdings of 900MHz spectrum are clearly not a substitute for clean 800MHz spectrum it is dangerous to extrapolate mechanistically from the auctions in the UK or auctions elsewhere to assess the market value of 900MHz spectrum; either directly via the price per MHz realised at auction or indirectly via the Additional Spectrum Methodology. It may be that Ofcom already recognises this point. However it is critically important to Vodafone that, prior to the auction, in order to give us the certainty that we require, Ofcom goes further than to say that "..such market valuations will be interpreted with care and not applied mechanically to set reference rates and AIP rates".[26] Specifically Ofcom should explicitly recognise that 900MHz spectrum must have a lower market value than 800MHz for the reasons detailed in this consultation.[27]

84. Given that the amounts paid in the auction may be an unreliable indicator of the market value of 900MHz Ofcom should seek other suitable benchmarks. Additional methodologies are required because the UK auction will not yield any indication as to how much lower the value of 900MHz spectrum is versus 800MHz spectrum. We suggest two methods:

    a. the amounts paid for 900MHz spectrum in auctions where this band is sold alongside 800MHz spectrum since this can give an indication of the relative values of the two spectrum frequencies. The auctions in Austria, Ireland and the Netherlands this year will fit this description.[28]

    b. estimates derived from technical and cost modelling can also provide a valuable source of benchmark data. We turn to this at the end of this section.

ALF and distortion in the auction

85. Ofcom recognises that "a mechanistic link between auction prices and ALF can create incentives for ALF payers to shade bids or not to

[25] http://www.yougov.co.uk/services/services-synd-DongleTrackasp?submenuheader=4, noted in paragraph 6.69 of the Briefing Paper.
[26] A13.85
[27] In our previous response we listed other reasons why the market value of 900MHz may lie below that of 800MHz; for example the cost of clearing the 900MHz band. See paragraph 157.
[28] Ofcom should note that the price of 900MHz in the Portugal and Spain joint-auctions represents a clear **overestimate** of market value, since in both cases 900MHz sold for the reserve price and in both cases the auction ended with unsold 900MHz spectrum. In these instances the price of 900MHz was 30% lower than 800MHz.

bid at all".[29] However it suggests that this risk is low, particularly if there is a pre-defined floor for ALF (which minimises any pay-off from bid shading because the ALF cannot go below the level set by the reserve price for 800MHz spectrum) and/or there are multiple bidders with values close to each other, in which case ALF will be set by the price of the losing bidder; so shading just makes a marginal change in who sets the price which therefore has only a limited impact on ALF. Vodafone disagrees with this analysis for a number of reasons:

a. using the reserve price to reduce the distortion caused by linking ALF to auction prices is just 'throwing the baby out with the bathwater'. There can be no sense in which a reserve price set by a regulator can represent the 'full market value' of 900MHz spectrum. It is possible for instance that not all of the 800MHz will sell at the reserve price (if it is set too high) in which case it cannot be said to reflect "full market value" of 800MHz, let alone 900MHz. If the 800MHz band attracts exactly as many bids as licences available i.e., six bids (something which has happened in other auctions in Europe) then the reserve price must still exceed market value for 800MHz. The market value is set by marginal demand, and so should be the price at which the spectrum would attract a seventh bid (which must therefore be lower than the reserve price). In the recent Spanish and Portuguese auctions with 900MHz and 800MHz sold simultaneously, attempts to set the 900MHz reserve price at or close to the 800MHz reserve price resulted in unsold 900MHz spectrum indicating that this price clearly exceeds the market value of the 900MHz.

b. it is not obvious that there will be a 'losing' bidder in the 800MHz band. There may be four bidders and four winners (e.g., because of the floor for the fourth operator). The price for 800MHz will then be set by the marginal values that winners express for packages *larger* than their actual winning package, and as explained in paragraphs 89 to 93 below, this can be influenced by bidders in the supplementary round, where there is very little incentive to report values truthfully, and every incentive to try to manipulate prices (and ALF).

c. even if there is a losing bidder, the chance of that bidder having a value *far* below the value of the next-placed bidder seems very high. Consider for example the difference between a 5th bidder with no existing spectrum or network setting the prices, rather than a fourth bidder with existing assets. Indeed a 5th bidder did not even turn up to the auction in Italy and Germany.

[29] A13.43

d. the distorting impact of ALF is much higher than the 1:1 ratio discussed in Ofcom's examples. Under Ofcom's proposals Vodafone and O2 will be paying up to 3.5 times the increment in the price of a 2x5MHz 800MHz block in ALF fees for 900MHz. EE will be paying up to 4.5 times the increment in the price of a 2x5Mz 800MHz block in ALF fees for 1800MHz. We note that, even in Ofcom's own examples, the efficiency impairment from the ALF distortion is large: in the final example (Table 13.6), Bidder 1 with a value of 1900 for an 800MHz lot loses the lot to Bidder 2 with a value of 1400.

86. In summary, setting the reserve price at a level which deters bid shading merely exacerbates the unreliability of using the auction price of 800MHz to assess the market value of 900MHz. Even if the reserve price is set at a level which will flush out a market price for 800MHz spectrum, there is still a potentially large distortion in the auction (in both directions) from the linkage of ALF to auction prices. This is not rectified by the new Additional Spectrum Methodology. We turn to this below.

Additional Spectrum Methodology

87. Vodafone welcomes Ofcom's proposal to introduce other methodologies for calculating ALF. However, we are concerned that the proposed Additional Spectrum Methodology based on auction bids is defective. We have identified here at least three problems:

a. bidders in the auction will not in fact be bidding for additional 800MHz spectrum; their valuations depend on a fixed, known quantity of 800MHz spectrum and the competitive consequences of winning a portion of that spectrum in comparison with other bidders and winners. It is unreasonable to assume that bidders would have made the same bids if ─ hypothetically ─ additional 800MHz spectrum had been created and somehow made available.

b. Ofcom's intent in the proposed additional spectrum methodology is that Vodafone's bids would not affect the assessed value of Vodafone's 900MHz spectrum and Telefonica O2's bids would not affect the assessed value of O2's 900MHz spectrum. However, this is unrealistic, since if the methodology did in fact lead to very different prices, Ofcom would feel obliged to consider the average of the prices (in conjunction with the other methodologies) when setting the annual fees. Setting actual ALF differently for the two operators would be very problematic. Since Vodafone's bids will in fact affect the average (as well as the linear reference prices, as before), the distorting impact on the auction will remain.

c. [Confidential].

88. The Additional Spectrum Methodology therefore does not alleviate the problem of distortion in the auction caused by the linkage of ALF to auction fees.

Price Caps and ALF

89. [Confidential].

90. [Confidential].

91. [Confidential].

92. [Confidential].

93. [Confidential].

94. One suggestion would be to eliminate the final primary round cap and return to an auction based on the relative price cap. This would also remove the need to make the new eligibility-exceeding "capped" primary round bids (and the complex associated rules) since there will be no strict requirement that bidders bid for their most profitable package in every round. However, this would not entirely address the problem, because even the relative cap will be sufficient (in a number of cases) to ensure that the outcome of the final primary round will not be overturned.

95. An alternative to address these problems would be to keep the final primary round cap, but then dispense with the supplementary round if the primary rounds have already finished with demand exactly matching supply in all categories. Alternatively, if there is a slight mismatch between supply and demand (e.g. a slight shortfall in demand in some category), then we suggest the following procedure:

    a. calculate a winning outcome and second-prices on the basis of selling **only** the lots that were bid for in the final primary round. The winning outcome should be identical to the set of final primary round bids; the second prices will in most cases be set close to the penultimate and final primary round prices. Inform each winner of the price they will have to pay for their winnings so far.

    b. then hold a supplementary round, but accept bids **only** for the lots which were ***not*** sold in the final primary round. Any winning package in the supplementary round will then be won in addition to a bidder's winning package from the final primary round.

96. We believe that this solution is in the spirit of the final primary round cap, while removing distorting bidding incentives in the supplementary round, and probably simplifying the supplementary round (since there will only be a few packages left to bid for). There is also a reasonable chance that the supplementary round will not need to be run at all.

Floors and ALF

97. [Confidential].

98. [Confidential].

99. [Confidential].

100. [Confidential].

101. [Confidential].

102. [Confidential].

103. Accordingly, we ask that Ofcom takes measures to reduce the risk of such an aggressive price-distorting strategy. One remedy would simply be to abandon the 'floor' concept in favour of the 'competition credit' approach already alluded to in the latest consultation. Ofcom could grant "opted in" bidders a competition credit up to a pre-set maximum which would then represent the maximum inefficiency considered acceptable for the purposes of promoting competition. If an opted-in bidder wished to pursue a price-inflating strategy, they could only inflate so far until they also ran into the risk of paying inflated prices. In Annex 4, we include a worked example of how competition credits could work.

104. Ofcom should also request timely deposit payments up to 100% of a bid placed if it saw signs of a bidder apparently inflating prices. This would ensure that such a bidder could not inflate higher than its available auction budget and cash-flow allowed.

105. Our proposal of calculating prices after the end of the primary rounds (and making only unsold spectrum available in the supplementary round) would also reduce the potential for bidders to divert competitors' budgets. In the price-inflating scenario discussed, the other bidders would discover just how much budget they have left to bid (in the supplementary round) for any unsold 800MHz and the higher frequencies.

Valuing the 900MHz spectrum

106. In Annex 6 Ofcom notes in paragraph 5.19 that "in part spectrum will be valued because it allows a national wholesaler to avoid network build costs". We agree, and it is this observation which has, to date, been at the heart of Ofcom's methodology for accessing the value of spectrum.

107. Vodafone believes that there are a number of advantages to this technical and cost methodology.

    a. It can be used to calculate the 'full market value of spectrum' as required by the Direction. This has been recognised by Ofcom in its previous statements on the setting of spectrum fees. In the Framework for spectrum pricing consultation, Ofcom explains the traditional method for setting AIP: "fee levels are set administratively by reference to the regulator's estimate of the **value** of the spectrum rather than directly by the market as in an auction". (paragraph 1.10 – our emphasis). In paragraph 1.12 Ofcom notes that (our emphasis) "AIP acts as a proxy for **market** prices for scarce spectrum…it promotes optimal use by ensuring that users face a signal of opportunity cost..". Ofcom re-iterates in paragraph 2.52 that "[t]he opportunity cost is the **price that would emerge in a well functioning market and reflects the value of spectrum** to the best alternative use..". (our emphasis). In its February 2009 Consultation on the *Application of spectrum liberalisation and trading to the mobile sector*, Ofcom explained at 1.8(d) that it proposed to "review the level of Administered Incentive Pricing (AIP) applying to the 900 MHz and 1800 MHz spectrum so that in future it reflects the **full economic value** of this spectrum post liberalisation, so as to encourage its efficient use". (our emphasis)

    b. There is no risk of distortion to the auction. Because the estimates derived using this method are not linked to the prices paid in the auction, there is no risk of operators shading their bidding or others trying to inflate ALF.

    c. The LCA method can reflect the fact that 900MHz is not a substitute for 800MHz. The technical methodology can be used to estimate the opportunity cost to Vodafone of having less spectrum to run HSPA at 900MHz. If Vodafone were to 'lose' 2x5MHz of 900MHz spectrum, then that 3G voice and data traffic would need to be carried over 3G spectrum at 2100MHz. The costs of adding capacity to a 3G network are known and readily attainable enabling Ofcom to estimate accurately the opportunity cost (and therefore the value) of the spectrum. Indeed, much of the data required may be already contained

within the model used by Ofcom to estimate the cost of terminating inbound calls.

d. The necessary modelling and analysis can be done by Ofcom before the auction (which could be at least a year away) and form part of the post-auction consultation. Ofcom has, to date, been at pains to stress that it can perform these calculations robustly and set the level of AIP to incentivise mobile operators (and others) to use their spectrum efficiently. Indeed, unless Ofcom is convinced that it can estimate the value of spectrum accurately using technical modelling, then it should have no business setting an AIP on this basis for any spectrum because of the risk that it would lead to a non-optimal allocation of spectrum (in contradiction of its duties). Put simply, if the AIP is too low, then operators may keep hold of spectrum even if it has a higher value (and therefore can be put to a better use) in the hands of others or if the AIP is set too high, then an operator may give up spectrum for another when it shouldn't because it is inefficient (and detrimental to society) to do so. There is no evidence of either situation to date.

108. In paragraphs A13.60-13.62 Ofcom gives a number of rather weak reasons for not using technical and cost modelling as a benchmark for setting the ALF:

a. *Technical and cost methodologies are subject to a considerable margin of error, especially in relation to technologies that are in the early stages of commercial deployment such as LTE*. These alleged errors have not prevented Ofcom from estimating AIP in the past. Furthermore, it is our case that it follows from Ofcom's analysis that using estimates of the value of 900MHz from the price paid for 800MHz will be subject to potentially larger errors because 900MHz is not a good substitute for 800MHz and the price of the latter could reflect 'distorted' bidding intended to drive up the cost of the former. For the calculations that Vodafone is proposing, Ofcom would not need to use data in relation to LTE; the Least Cost Alternative methodology would use the robust and widely available data on 3G costs.

b. *This approach could potentially lead to ALF rates that appeared out of line with full market value as inferred from the auction*. It may be that the technical and cost methodology could lead to estimates that differ considerably from the full market value as inferred from the auction. However, since Ofcom has previously been convinced that the LCA method can be used to estimate the market value of spectrum, this is potentially very useful information. It could, for example, indicate that the full market value inferred from the auction is overestimating the market value of 900MHz spectrum for the reasons detailed above and

covered extensively in the auction discussion. Indeed, Ofcom has warned recently about the dangers of setting spectrum fees too high: "[w]e agree that over pricing spectrum consistently over the long term will lead to inefficient and non-optimal use of spectrum as this will deny access to spectrum to those who could deliver additional benefits to society were fees at the right level."[30]

c. *This puts into question the benefit of undertaking the complex technical and cost modelling exercise in the first place*. On the contrary, because the price paid for 800MHz is not a good proxy for the market value of 900MHz, an additional source of information which lacks the distortive properties of auction prices must be invaluable. Moreover, because the auction is still many months away, Ofcom will have sufficient time to carry out the necessary modelling. Ofcom could even choose to consult on the composition of the technical model before the auction.

109. There is no perfect way of estimating the value of 900MHz spectrum short of auctioning it at the same time as the 800MHz and 2.6GHz spectrum. Since this does not form part of Ofcom's proposals, it has to find alternative methods which fulfil the requirements of the Directive and are consistent with Ofcom's duties. Ofcom is wrong to dismiss the technical and cost method as a benchmark because it can compensate for many of the disadvantages of using auction prices for which the spectrum which is subject to ALF is not a good substitute.

110. Indeed, none of Ofcom's now professed doubts about the accuracy of its AIP calculations have emerged in the past. As recently as December 2010 Ofcom was confident that it could set AIP fees "..at a price that would emerge in a well functioning market".[31] Indeed Ofcom is so confident in its ability to assess the opportunity cost (value[32]) of spectrum that it believes that imposing an AIP "…can play a role in signalling the opportunity cost of scarce spectrum and ensuring that there is an incentive for spectrum to move from lower value to higher value uses".[33]

111. We accept that at the time of its consultation on ALF, Ofcom will be left with a range of potential market values for the 900MHz; where Ofcom chooses to pitch the ALF should be consistent with its legal duties. In Annex 3 we reiterate our concerns that Ofcom's proposed approach to setting ALF is inconsistent with its obligations under Community and domestic law.

[30] See the Revised Framework for Spectrum Pricing paragraph 4.336
[31] 1.7.
[32] Ofcom explains in paragraph 4.73 that "[i]n a well-functioning market, the price of spectrum would be equal to the value of that spectrum in the next highest value use".
[33] 4.33

Summary

112. Vodafone has a number of serious concerns with Ofcom's proposed method for calculating the ALF. Spectrum in the 800MHz and 900MHz bands are not near term substitutes and so the price of the former cannot be used to estimate the market value of the latter. Moreover, ALF based on auction prices can seriously distort the auction. Ofcom acknowledges this effect, but appears to be in denial about the potential scale of distortion; both by ALF payers shading their bids and non-ALF bidders inflating the price for others of both spectrum and ALF. Neither of these effects is ameliorated by the Additional Spectrum Methodology; although removal of the primary round cap/supplementary round and replacing the reserved spectrum with competition credits can significantly reduce the potential for distortion by non-ALF payers. We call upon Ofcom to give serious consideration to these suggestions.

113. The technical analysis used by Ofcom to date suffers from none of the disadvantages above and there is no valid reason to continue to refuse to include it as a methodology. Auctions held elsewhere may also provide a useful benchmark where 900MHz spectrum is sold alongside 800MHz. However, considering only the prices of 800MHz spectrum from other auctions, although they may be free of the distortive effects to which the UK auction is vulnerable, still suffers from the fatal flaw that 900MHz is not a good substitute for 800MHz.

114. Ofcom has said that it will consult on the setting of ALF after the auction. However the statements in the current consultation lack sufficient clarity for operators to be able to make well informed bids in the forthcoming auction or in any private sale of the 1800MHz spectrum. We ask that Ofcom endeavours to reduce this uncertainty by: acknowledging the deficiencies in using auction values to set ALF; stating that it will include the technical methodology in its calculation of ALF; and making the changes in the auction rules that we suggest to remove the potential distortion caused by non-ALF payers.

Section 3: Answers to Specific Questions

Question 4.1: Do you agree with our assessment of the competition concerns relating to national wholesale competition that could arise if the auction took place with no measures to promote competition? Please state your reasons for your views.

Question 4.2: Do you agree that option 4 should be adopted to promote national wholesale competition? Please state the reasons for your views.

No. We believe that the risk that a fourth operator will be unable to acquire spectrum in the auction is vanishingly small and that the reservation of spectrum is therefore a disproportionate measure given the risks of a consequent inefficient allocation of spectrum.

Question 4.3: Do you agree that the portfolios in group 2 (middle portfolios) of option 4 are likely to be most appropriate and proportionate implementation of this option?

No. We do not believe that any spectrum should be reserved for a fourth operator. If Ofcom is still minded to reserve spectrum, then there is certainly no case that 2.6GHz should be included in any portfolio. Experience from elsewhere casts serious doubt on whether smaller operators actually need 2.6GHz spectrum (over and above an allocation of either sub-1GHz spectrum or 1800MHz). If they do, then they appear able to acquire it despite the alleged potential payoff to strategic investment on the part of other bidders.

Question 4.4: Do you believe that geographically split licences for a particular block of 2.6 GHz spectrum between standard power use and lower power use is likely to create significant additional benefits for consumers?

Question 4.5: Please provide your views including the reasons for them on which options you believe should be taken in relation to promoting low power shared use of 2.6 GHz spectrum.

In June 2011, Ofcom issued a "Consultation and information on technical licence conditions for 800MHz and 2.6GHz spectrum and related matters", which included several questions on low power shared access. In its response to that consultation, Vodafone commented on several issues relating to low power shared use that are relevant to the current consultation:

- The potential for sub-national RAN operators to develop innovative business models using LTE in the existing 'DECT Guard Band' shared low power spectrum should be considered.

- The most appropriate frequency for locating low power shared access blocks in the 2.6GHz band is within the unpaired spectrum, because there are unpaired blocks that already have a low power limitation.

- The proposed out-of-block EIRP limits (which are mandated by Commission Decision 2008/477/EC) were developed for high power macrocell networks, not low power networks. Applying these limits to low-power-only networks has the potential to cause harmful interference to networks operating in neighbouring blocks.

The whole of the June 2011 document was described as an impact assessment (Para. A5.1), so Ofcom should consider all representations that were made in response.[34] However, there is no evidence in the current consultation document that this has happened; in particular, there is no mention whatsoever of technical licence conditions for the 2.6GHz band or the points that were made by Vodafone in its response.

In para 4.239, Ofcom states that:

> *"Overall, our **provisional** conclusion is that it is **possible** that shared low power use of 2.6 GHz might constitute an opportunity for disruptive entry into the mobile market bringing significant benefits to consumers which **could** be greater than the value that use of that spectrum in the hands of the existing national wholesalers might generate." "While it is possible that such **entry could occur without reservation** we have identified that there is **some** risk that it **might** not."* (our emphasis).

Ofcom seems very uncertain on the potential for low power shared access, and has not provided any evidence to support its provisional conclusion.

Ofcom requests evidence of the costs and benefits of low power shared use. Ofcom already has evidence of the benefits to consumers of spectrum for low power shared use – or rather, the lack of benefits – through the shared licences for the "DECT guardband" that it awarded in 2006. To our knowledge, there has been only one attempt to provide consumer services using this spectrum, and that was small, short term and unsuccessful.[35] In contrast, the value of 2.6GHz spectrum to national wholesalers has been convincingly demonstrated by the auctions that have already taken place in many countries.

There is no evidence that low power use will create any significant benefits to consumers, and geographically split licences will not alter this fact. However, as Ofcom notes, a geographically split licence would require further work to

[34] In its response, Vodafone made it clear that all of the response constituted representations on the impact assessment.
[35] In 2008, Mapesbury Communications briefly launched a service in parts of the London Borough of Newham.

specify fully and would further complicate the licence award, both for Ofcom and participants. It could also distort the award, by creating lots with unequal value.

Ofcom still has a considerable amount of work to do to complete the essential parts of the licence award; Vodafone therefore urges Ofcom not to pursue further either geographically split licences or the hybrid approach.

As Vodafone stated in its response to the June 2011 consultation on technical licence conditions, we believe that the unpaired spectrum is the most appropriate location for low power shared use within the 2.6GHz band. This would have a lower opportunity cost than paired spectrum, because:

- Part of this spectrum is already subject to power limitations.
- The price of 2.6GHz unpaired spectrum in recent auctions in Europe has been around half that of paired spectrum (see paragraph A9.18 of the consultation document).

However, this consultation document continues only to consider shared use within the paired spectrum, without any discussion of why this is the optimal use of spectrum within the 2.6GHz band as a whole.

Regarding Options A and B:

> *"Ofcom's vision for spectrum management, as set out in the SFR, is for market forces to play an increasingly important role in determining how spectrum is used. Ofcom believes that this will encourage efficiency in spectrum use, by increasing the likelihood that spectrum will be held by those who can make best use of it, and by creating more freedom for spectrum to be used for more valuable applications."* (Spectrum Framework Review: Implementation Plan, Para. 1.3)

We could not have found better words to justify why Ofcom should follow Option B (aggregation of bids) for any shared use of 2.6GHz spectrum.

Question 5.1: Do you have any comments on the proposal to include a coverage obligation in at least one of the 800 MHz licences, and the proposed extent of such a coverage obligation?

In the previous consultation Ofcom's objective in proposing and setting the coverage obligation was that the costs of compliance were relatively low. Ofcom estimated that upgrading the existing 2G mobile network of a 900MHz operator to LTE using 800MHz spectrum could provide a 2Mbps service, with 90% coverage confidence indoors, to an area within which 95% of the UK population lives.

In our response to that consultation we argued that Ofcom may have underestimated the cost of achieving the proposed coverage obligation. Ofcom is now proposing to impose a coverage obligation beyond 95%. The work by realwireless suggests (on the basis of four sample areas) that extending coverage to 98% may cost at least another £400m and yet Ofcom does not examine whether it is proportionate to extend the obligation to 98%; nor does it consider whether the extended coverage obligation will favour any particular operator and what it might mean for the reserve price of the spectrum with the obligation (accepting that this will be the subject of a separate review). We submit that Ofcom should investigate these matters before deciding on the coverage obligation.

Question 5.2: Do you have any comments on which of the two approaches proposed for the specification of such an obligation would be preferable: Approach A, which would require the licensee to provide a 4G mobile data service to an area within which at least 98% of the UK population lives; or Approach B, which would require the licensee to provide the specified mobile data service with coverage comparable to the combined mobile voice coverage of today's 2G networks and in addition to provide the same service with coverage comparable to that of the additional mobile voice coverage achieved through the MIP, in those areas where MIP infrastructure is capable of supporting a 4G mobile data service?

It is quite difficult to comment on the relative merits of the two possible obligations because Ofcom is not explicit about what is 'coverage comparable to the combined mobile voice coverage of today's 2G networks' and how an operator would know whether it had met this obligation.

We also see a risk that the location and nature of the MIP infrastructure is not known at the time of the auction. If bidders cannot accurately assess the cost of meeting the coverage obligation, then this may introduce some inefficiencies into the auction.

Question 5.3: Do you have any comments on our assessment that it is unlikely to be proportionate to impose such a coverage obligation on more than one licensee?

Vodafone agrees. The coverage obligation will embrace geographic areas of the country where, to date, it has proved uneconomic to provide coverage. It would therefore seem disproportionate and wasteful to impose a coverage obligation on each of the licensees.

Question 5.4: Do you have any views on the costs and benefits of a wholesale access obligation on the licensee with the coverage obligation in respect to those areas beyond existing 2G mobile voice coverage?

We do not support the imposition of a wholesale access obligation on the licensee with the coverage obligation. Although we are not convinced that the regulatory costs of such arrangements represent a material impediment, we believe that access arrangements of this nature should be left to commercial negotiations.

Question 5.5: Do you have any comments on the possibility that we may in certain limited circumstances consider granting concurrent licences as set out in paragraphs 5.88 to 5.93?

Vodafone is concerned with the rather ill-defined circumstances under which a concurrent licence could be issued. We believe that such licensing should only be done with the consent of the licence holder (such consent should not be unreasonably withheld), and that the original licence holder should be reimbursed for any reasonable costs incurred in managing co-ordination.

Question 6.1: Do you agree with our revised proposals for the packaging of the 800 MHz band? Please state the reasons for your preference.

Vodafone welcomes Ofcom's proposal to move towards generic 'A' lots in the auction design; we favour the fewest number of categories possible. We question whether there is really a need to designate a special A2 lot with the coverage obligation. The holder of the coverage obligation could be decided in the assignment stage from among any winner of at least 2x10MHz of 800MHz spectrum away from the bottom two frequencies. Accordingly, winners of at least 2x10MHz would be bidding for a combination of an assignment position with or without the coverage obligation. This would allow (for instance) bidders who have won 2x10MHz to consider whether it is preferable to win the lower two blocks (with a guarantee of no coverage obligation) versus the middle or upper blocks (with a probable coverage obligation). We believe this is likely to lead to the most efficient assignment of blocks based on consideration of different relative impairments, while keeping the primary stage as simple as possible, and facilitating maximum flexibility regarding choices of neighbour in the assignment stage.

If, however, Ofcom chooses to retain distinct A1 and A2 lots, then we would recommend that the reserve price for the A2 lot (with obligation) be set at a lower initial level to reflect a reasonable initial estimate of the cost of meeting the obligation.

Question 6.2: Do you agree with our revised proposals for the packaging of the 2.6 GHz band? Please state the reasons for your views.

We support the revised proposals for packaging the paired and unpaired 2.6GHz band. We believe that the increased flexibility will lead to a more efficient allocation of spectrum.

Question 7.1: Do you agree with our revised proposals for the number of eligibility points that should attach to each lot? Please state the reasons for your views.

Vodafone believes that eligibility points should reflect (roughly) the relative values of spectrum, as should the relative reserve prices. Given this, there are some slightly odd features of Ofcom's latest proposals as described in Figure 6.10. First, the eligibility of the Category B lot (2x15MHz of 1800) is set equal to the eligibility of 2x10MHz of 800, suggesting a 3:2 value ratio. However, previous auctions have revealed a roughly 2:1 value ratio between the 800MHz and 1800MHz bands and the proposal for calculating ALF which Ofcom describes in Annex 13 also suggests an approximately 2:1 value ratio.

Ofcom proposes far fewer points/MHz for 2.6GHz than for 1800MHz spectrum. This conflicts with its proposal in Annex 13 for using the price of 2x45MHz of 2.6GHz as a benchmark for the ALF on 1800MHz spectrum. We think these anomalies could be reduced by returning to a 2:1 eligibility (and reserve price) ratio between 800MHz and 1800MHz, so that the Category B lot receives 45 eligibility points.

The decision to use fractional eligibility points in the case of unpaired lots (Category E) is unusual; auction software generally works with integer numbers of points and auction designers generally increase the points for larger categories rather than use fractional points.

Question 7.2: Do you have any comments on the proposed auction rules as explained in section 7, Annex 11 and Annex 12? Please state the reasons for your views.

While the proposed new rules are complex (on top of a lot of already existing complexity in a CCA), we believe that most of the complexity encourages truthful bidding and yields price discovery information.

In particular, we welcome the proposal to provide bidders with information about demand in the primary rounds which reflects whether "opted in" bidders are still (in effect) competing at the current round prices. If Ofcom insists on granting 'floors', some mechanism like this is required.

However, we reiterate that we do not see a proportionate justification for reserving floors for a fourth bidder, and that the floor concept may allow unwelcome price-distorting bidding [Confidential]. We urge Ofcom to abandon the 'floor' concept, and move towards the "competition credit" approach

mentioned in this consultation. Ofcom could grant "opted in" bidders a competition credit up to a pre-set maximum, which would then represent the maximum inefficiency that is considered acceptable for the purposes of promoting competition. If an opted-in bidder wished to make use of the competition credit, then it would need to continue bidding, but the credit would be deducted from the current round-price bid and the (competitive) auction price (see Annex 4 for a worked example).

We also have some serious concerns about the novel cap rules, in particular the final price cap (in addition to the relative price cap). [Confidential].

Question 8.1: Do you have any comments on the Additional Spectrum Methodology as one of several sources of information for estimating the full market value of spectrum?

Vodafone welcomes Ofcom's proposal to introduce other methodologies for ALF. However we are still concerned that the proposed Additional Spectrum Methodology based on auction bids is defective. We have identified at least three problems:

a. Bidders in the auction will not in fact be bidding for additional 800MHz spectrum; their valuations depend on a fixed, known quantity of 800MHz spectrum being available, and the market consequences of winning a portion of that spectrum in comparison to other bidders and winners. Therefore it is unreasonable to assume that bidders would have made the same bids if – hypothetically – additional 800MHz spectrum had been created and somehow made available.

b. Ofcom's intent in the proposed additional spectrum methodology is that Vodafone's bids would not affect the assessed value of Vodafone's 900MHz spectrum and Telefonica O2's bids would not affect the assessed value of O2's 900MHz spectrum. However, this is unrealistic, since if the methodology did in fact lead to very different prices, Ofcom would feel obliged to consider the average of the prices (in conjunction with the other methodologies) when setting the annual licence fees. Setting actual ALF differently for the two operators would be very problematic. Accordingly, since Vodafone's bids will in fact affect the average (as well as the linear reference prices, as before), the distorting impact on the auction will remain.

c. The proposed methodology provides a means for *non*-holders of 900MHz spectrum to inflate ALF fees for competitors. [Confidential].

Question 8.2: Do you have any comments on our updated thinking on estimating full market value for the purpose of revising ALF as set out in this section and Annex 13?

Vodafone has a number of concerns with Ofcom's proposed method for calculating the ALF. It is clearly intended that the forthcoming auction will play a part in the assessment of the ALF. This risks distorting, in opposite directions, the bidding of participants who pay ALF and those that do not. Even in the absence of such distorting effects, 900MHz is not a good substitute for 800MHz spectrum, and therefore using the price of the latter to estimate the value of the former is likely to involve material errors. We therefore suggest that Ofcom weights its calculation of ALF towards the technical methods that it has used in the past, together with other data from auctions where 900MHz spectrum is sold alongside 800MHz; both provide more reliable estimates of the market value of 900MHz spectrum. In addition, we suggest that Ofcom takes measures to mitigate the risk of fourth operators driving up the price of ALF (and therefore distorting the outcome of the auction) by making the changes to the auction rules described in section 2.

Question A7.1: We would welcome comments on any aspect of the data, assumptions and modelling methodology we have used in our technical analysis, in particular our approach to serving users in a range of both easier and harder to serve locations.

Question A7.2: We would welcome any additional information, in particular from current operators, on the choice of parameters making up our 'Min var and 'Max var' cases.

Please see our technical analysis contained in Annex 2. We argue that the available evidence overwhelmingly supports the use of the Min var parameters. Building on this we use much of Ofcom's technical analysis to show that a fourth operator with spectrum from the smaller portfolios will be a credible competitor in terms of coverage, speed and capacity.

Question A8.1: Do you agree with our assessment of when Everything Everywhere, Vodafone and Telefónica are likely to be able to refarm their existing 2G spectrum? In particular, do you agree with our views on the importance of user devices and the likely availability and take-up of devices that use different technologies and bands? Please state the reasons for your views, including if appropriate your views on handset roadmaps and the practical constraints which apply to those roadmaps

We refer Ofcom to our previous submissions. We believe that it should be possible for Vodafone to re-farm a total of 2x10MHz of 900MHz spectrum by [Confidential]. In order to reduce the differential in performance between HSPA and LTE this band will need to be cleared of <u>all</u> voice traffic. As we said in our follow up submission to Ofcom:

> "[Confidential].[36]

[36] [Confidential]..

“[Confidential].

Annex 1

Competition effects

In this Annex we explain further why Ofcom's analysis of the possible competition effects if there was a reduction in the number of national wholesalers is speculative and unreliable.

Unilateral effects

Ofcom considers that the present market is already highly concentrated, and yet the UK mobile sector appears to have been competitive to date, delivering a wide range of benefits for consumers. These observations should have led Ofcom to question the relationship between concentration and competition in the UK mobile market.

This relationship depends on two key factors.

- the extent of differentiation between the firms in the market; and
- the extent to which firms can expand their capacity and/or face capacity constraints.

Where firms are homogenous (they offer similar services), and do not face capacity constraints and/or can adjust capacity in response to demand, market outcomes will be at the competitive level as long as there are at least two firms in the market.

Ofcom's competition assessment does not explicitly identify what type of competition it is concerned with, nor does it assess the level of differentiation between firms or the nature of capacity. Accordingly, it is not possible for Ofcom to conclude that a reduction in the number of national wholesalers from four to three would make a material difference to the level of competition in the market, and Ofcom's conclusions regarding unilateral effects are unsupported.

In particular, Ofcom's second consultation fails to assess two specific aspects of competition.

- *Competition between vertically integrated MNOs to invest in their network to offer a better service to their retail customers*: whether strong competition at the retail level (as recognised by Ofcom) will continue to provide an incentive for network operators to invest in their networks to enhance their competitive position at the retail level.
- *Competition between national wholesalers to offer wholesale network access to MVNOs*: whether the ability of wholesale operators to adjust their capacity through network dimensioning, coupled with the homogenous nature of the product, means that

MVNOs can generate competition between the remaining three firms just as effectively as they could between four firms.

Ofcom has found that there is presently a competitive retail market, with competition taking place between the MNOs, H3G, and MVNO operators. As a consequence, if there is an opportunity for a competitive advantage to be gained at retail level by a vertically integrated MNO through an investment in its network, then each MNO will be incentivised to do so. If it does not, then the other MNOs will, and it will lose retail customers. Specifically, there are two variants of this situation:

- *Competition between wholesalers to fill capacity gaps*: knowing that for any commercial opportunity there will be at least one other firm trying to fill a capacity gap, any wholesaler would seek to be the firm that invested in capacity. This is because it would benefit from the higher market share achieved, while it would suffer the effect of lower market prices following increased capacity whether this capacity was created by itself or by a rival.
- *Competition between wholesalers in service enhancing investments*: if there were an opportunity to improve one's position in the retail market through a network investment, then strong competition between firms at retail level would result in strong competition at the network level. Knowing that the firm that invests first would gain a first mover advantage at retail, each network operator would realise that if it did not invest it would hand its rivals a competitive advantage. This competitive pressure creates a "prisoners' dilemma", where all firms would collectively prefer not to invest, but for each individual firm investing is a dominant strategy.

This would be the case if the market were characterised by the following features:

- homogenous capacity between national wholesalers;
- equality of opportunity to create new capacity, enhance existing capacity, or to develop new service enhancements; and
- at least two firms with the ability and incentive to fill any perceived capacity gap or to develop relevant network enhancements.

In this case, a market with three credible national wholesalers would be expected to be as competitive as one with four. Without assessing these points, Ofcom cannot reliably conclude that a reduction in the number of national wholesalers would result in a material reduction in the level of competition within the market.

Similar considerations apply to competition between national wholesalers to offer wholesale network access to MVNOs. If there are two or more wholesalers who each have the ability to supply a MVNO with similar network services, then a MVNO would be able to trade one wholesaler off against

another. And this would potentially include competition to offer an MVNO deal to H3G if it were to leave the wholesale market. Each remaining wholesaler would rather make the sale at any positive level of margin, and prices would be driven down to the competitive level as a result as a process of undercutting would take place. In this situation "two is enough" – whether there are four or three wholesalers would make no difference to market outcomes.

For this to be the case, two key factors are relevant:

- wholesale capacity must be homogenous, so that each wholesaler is equally well placed to serve the MVNO's requirements; and
- network wholesalers must either have excess capacity, or must have the ability to flexibly increase capacity in response to an MVNO's request.

Again, Ofcom has not considered either of these factors, and so is not in a position to conclude that a market with three credible national wholesalers is likely to be less competitive that one with four.

Coordinated effects

When analysing whether coordination is likely to occur in a market, competition authorities employ the following framework:

- assessing whether there would be a focal point around which firms could tacitly coordinate, and that each firm that was a member of this agreement would understand which other firms were also members of this agreement;
- assessing whether it would be possible to monitor any deviations from this proposed agreement;
- assessing whether it would be possible for the participants to the agreement to punish any deviation from the agreement (internal stability); and
- assessing the prospects of any non-participant entering the market or expanding within the market to steal sales from the participants (external stability).

Ofcom's analysis fails to carry out these steps fully, either at the retail or wholesale level, and at best provides a partial assessment of only some of the steps.

Ofcom has not established the ability of mobile operators successfully to reach and monitor a tacit agreement. Ofcom cites several possible types of coordination:

- coordinating on retail prices;

- coordinating by "… agreeing not to compete for each others' customers without specifically coordinating on price" (paragraph 2.62 of Annex 6);
- coordinating to "… delay the introduction of innovative services or investment in networks" (paragraph 2.62 of Annex 6); and
- coordination by wholesalers "… in setting both wholesale and retail prices" (paragraph 2.62 of Annex 6).

In each case, Ofcom's analysis fails fully to describe how a stable tacit agreement could successfully be reached and maintained, and in doing so omits to consider several aspects of the mobile market that are material to the likelihood of coordination.

First, in relation to **coordination on retail prices**, Ofcom appears to accept the EC view that "pricing did not present the characteristic of transparency which would be necessary to reach common understanding on the terms of coordination" (paragraph 2.62 of Annex 6), on the basis that retail prices are complex and contain many variable elements. Ofcom does not present any alternative view as to how coordination on retail prices might successfully be reached. Moreover, in addition to the complexity of mobile tariffs, one should take into consideration the lack of transparency in mobile retail prices that arises from the fact that a mobile operator's effective prices cannot be observed by rival operators. This is because effective prices (as captured, for example, through a particular tariff's ARPU) depend not only on headline tariff rates but also on customers' usage patterns, which are not transparent.

In relation to **agreeing not to compete for customers**, Ofcom fails to explain how this would take place.[37] Given the accepted lack of transparency on retail prices, Ofcom has not set out how and why it considers both that (i) coordination can be sustained without reaching agreement on retail prices and (ii) how such coordination could be monitored without transparency on retail prices. As Ofcom has acknowledged, retail mobile markets are highly competitive, with many different competitive offers, and there is considerable customer churn. Yet, in this context, the Second Consultation does not address:

- How operators would be able to move from the current competitive environment to a coordinated outcome without being able effectively to reach agreement on or monitor each others' retail prices (and other aspects of the competitive offer). It is unlikely that coordination could be achieved simply through observing market shares and customer switching.[38]

[37] Indeed, the description of this form of coordination appears contradictory – Ofcom state that such coordination could take place *"without coordination on pricing"* whilst also suggesting that *"competing aggressively for its rivals' customers – for example on price – this would quickly become apparent to its rivals"* (paragraph 2.62 of Annex 6).

[38] Stability in relative market shares and customer switching patterns is potentially consistent with both a competitive and a successful coordinated outcome; whereas changing market

- How any coordination might be monitored when, given the prevailing level of customer churn, operators would be unable directly to determine whether customer switching was a response to one firm actively "competing" them away or the result of other factors – such as changing customer preferences and usage behaviour.

In relation to delaying the introduction of innovative services and network investments, Ofcom does not provide any reasoning as to why this form of coordination could arise. The Second Consultation does not suggest what these services are (or might be), and how firms might tacitly agree to delay something that does not yet exist. In particular, Ofcom does not describe how firms would:

- reach agreement on which innovations and investments were to be included in the tacit agreement (and which were not) when these services have not previously existed and are therefore not subject to the type of repeated interaction and opportunities for signalling that can give rise to coordination;
- reach agreement on the length of delay prior to launch when, for example, one operator might be ready to launch sooner than others (and so, even if it delayed its launch, other operators who were further behind might still interpret this as jumping the gun);
- observe and monitor each others' future plans prior to launch when these are commercially sensitive and confidential;
- have the incentive to delay introduction when, once one firm introduces a new innovative service (e.g. such as O2's exclusive deal with Apple for the iPhone), it can gain a sizeable and sustained competitive advantage that might be hard to retaliate against; or
- successfully punish deviation and restore coordination when the introduction of new products based on innovations or investments might be irreversible.

In relation to coordination in setting **both wholesale and retail prices**, Ofcom does not set out how any why it believes that coordination could take place at the wholesale level. Rather, having accepted that the necessary transparency for coordination on retail prices is not present, Ofcom simply notes that coordination at the wholesale level if it existed could prevent a competitive fringe of MVNOs from undermining retail price coordination. Ofcom has not considered the likelihood of wholesale coordination, and consequently cannot properly assess the potential for MVNOs to disrupt coordination at the retail level.

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shares and customer switching could be interpreted either as one firm signalling a move to coordination or equally as a sign of another deviating from a tacit agreement.

There are a number of considerations that are absent from Ofcom's Second Consultation that are potentially material to the prospect of wholesale coordination, including for example the fact that:

- several MVNOs already exist in the UK market, and have established market positions – operators would therefore face significant revenue losses from undermining the ability of these MVNOs to compete;
- negotiations between wholesale operators and MVNOs are commercially confidential to the parties and non-transparent – meaning that sufficient transparency required for wholesale coordination might not exist; and
- MNVO deals are struck only infrequently and are hard to unwind once agreed – this potentially limits the extent to which there is the type of repeated interaction that can give rise to coordinated outcomes, and limits the ability of rival operators to retaliate to restore a coordinated outcome when one firm deviates.

There are therefore strong reasons to believe that Ofcom's assessment of wholesale coordination is incomplete and inadequate. This raises the prospect that MNVO's could "constitute a competitive fringe that would undercut…retail prices" (paragraph 2.62 of Annex 6).

Annex 2

Technical Analysis

Network Performance with the smaller portfolios

In this Annex we demonstrate, using much of Ofcom's own technical analysis, that a network with access only to spectrum in the smaller portfolios can be a credible competitor in terms of coverage, speed and capacity.

We use a network of 18k sites as a 'unit of analysis' on the basis that H3G has stated that their network will reach 16k sites in the next 2 years.[39] Ofcom assumes that operators can add 1,500 sites per annum and therefore it is reasonable to assume that H3G could have a network of 18k sites by around 2015, or even sooner if it is able to share sites with others.

Ofcom introduces two groups of parameters which are intended to represent the lower (Min Var) and upper bound (Max Var) of a set of physical and technical parameters. Vodafone has examined in detail the merits of these two sets of parameters. We believe that the strong frequency dependency which is inherent in the Max Var set of parameters is not supported in publicly available studies and that their use in Ofcom's modelling is therefore inappropriate. The same is not true of the Min Var parameters and we use this set in the remainder of this section. A full description of our analysis of the relative merits of both sets of measures is included in this Annex.

At the end of this annex we again bring to Ofcom's attention an implementation error in its modelling which affects frequencies between 2000MHz and 3000MHz. This error means that the cell area of 2600MHz is underestimated by a factor of 1.67 in a coverage limited environment (the magnitude of the error will be less in an interference limited environment found in the denser parts of the network). The only way to quantify the effect of this error on Ofcom's published results is for it to re-run the simulations using a corrected implementation of the Extended Hata model.

Coverage

Ofcom shows that for a national network of 18k sites operating at 85% load (based on the West London study area) that 2x10MHz of 1800MHz is capable of delivering a 1Mbps service to 99% of locations (see Figure 3 Annex 7). These results are replicated for a 2x10MHz 800MHz carrier. In other words, Ofcom shows that the putative advantage of low frequency spectrum disappears when a large number of sites are deployed.

[39] http://www.three.co.uk/Discover/Network/The_future_of_our_network retrieved 1 March 2012.

For the Cambridge study area – which is used a proxy for a less populous area – we observe that for an 18k site network operating with 2x10MHz in the 1800MHz band the Ofcom model predicts that in the region of 97% of locations could be served under the same load conditions (see Annex 7 Figure 4).

In later graphs (Annex 7 Figure 12) Ofcom shows that with a 2x15MHz carrier at 1800MHz the model predicts that in rural areas the network would have >99% coverage.

Ofcom has examined the ability of a 2x15MHz 1800MHz carrier to provide coverage at various depths in building (between 5 and 15 meters) see Annex 7 Figures 7 and 8. For a large network of 18k sites the ability of an 1800MHz network to penetrate into buildings is virtually indistinguishable from an 800MHz network.

Ofcom therefore shows that a 2x10MHz carrier operating at 85% load in the 1800MHz band would be sufficient to provide coverage to between 97% and 99% of indoor locations with a network of 18k sites. A 2x15MHz carrier would improve coverage to 99% of indoor locations in rural areas. As Ofcom notes, coverage for the small proportion of indoor locations which are not covered could be served by other indoor technologies such as femtocells or Wi-Fi.

Speed

Ofcom presents single user throughput for a network of 18k sites using a 2x10MHz carrier at 1800MHz (see Annex 7 Figure 25). We can see that the model predicts that user throughput would be:

- >=1Mbps for 99% of indoor locations;
- >=2Mbps for 93% of indoor locations;
- >=5Mbps for 60% of indoor locations.

This result is relevant for a network which is loaded to 85%; clearly a network which operates at a lower load would be able to offer higher data rates to a larger proportion of locations (see Ofcom's Figure 31). The advantage of 2x10MHz at 800MHz versus a 2x10MHz at 1800MHz in terms of speed is shown to be negligible for a network of 18k sites.

Ofcom does not present directly comparable data for a 2x15MHz carrier at high load. However, it does show similar data under 50% load:

- >=1Mbps for >99% of indoor locations;
- >=2Mbps for >99% of indoor locations;
- >=5Mbps for 90% of indoor locations;
- >=10Mbps for 60% of indoor locations

Ofcom states that "[t]his clearly shows that networks with larger amounts of higher frequency spectrum are able to offer higher speed services to users at the majority of locations". (Annex 7.104)

Ofcom examines coverage of a 5Mbps service for a variety of building depths (see Annex 7 Figure 27). Its analysis shows that there is negligible difference between an 800MHz network and an 1800MHz network of 18k sites.

In summary Ofcom's technical analysis shows that an operator with 2x10 or 15MHz at 800MHz or 1800MHz is able to provide high data rates (2Mbps) to most locations under medium to high load conditions (99% and 93% of locations respectively). A 1Mbps service can be provided to 99% of locations under medium and high load conditions using either frequency.

Loading and Capacity

Ofcom presents charts (Annex 7 Figure 33) which show the maximum loading consistent with delivering a 5Mbps service versus the percentage of locations which would receive that service. The table below shows the results for an 18k site network for both a 2x15MHz 1800MHz carrier and a 2x10MHz 800MHz carrier.

	% of Location served		
Loading	10MHz at 800MHz	15MHz at 1800MHz	Additional locations served with 1800MHz
40%	85%	95%	10% points
60%	72%	87%	15% points
80%	63%	81%	18% points

A 2x15MHz 1800MHz network can consistently serve a higher percentage of locations when compared with a 2x10MHz 800MHz network under the same load; the gain in terms of locations served varies between 10 and 18 percentage points in favour of the 1800MHz network. This demonstrates clearly how networks with large quantities of higher frequency spectrum are able to operate at a high loading, provide a high bit rate and offer good levels of coverage.

Ofcom also examines the relative capacity of 2x10MHz 800MHz versus 2x15MHz 1800MHz for an 18k site network. Relative capacity is assessed in terms of number of simultaneous users versus the percentage of locations where 5Mbps is available. Some points from the chart in Annex 7 Figure 35 are tabulated below:

	% of Location served		
Relative Capacity	10MHz at 800MHz	15MHz at 1800MHz	Additional locations served with 1800MHz
1 user	88%	99%	11% points
2 users	74%	89%	15% points
3 users	63%	80%	17% points

Ofcom's analysis shows that 2x15MHz of 1800MHz is able to serve more locations at a higher loading than 2x10MHz of 800MHz for the same amount of loading (relative capacity). The gain is between 11 and 17 percentage points.

Summary

In summary, Ofcom's technical analysis of 800MHz and 1800MHz networks with spectrum in the smaller portfolio and around 18k sites demonstrates that:

- High levels of indoor coverage in the region of 99% can be achieved with a 2x10MHz network at either frequency operating at high load;
- High data rates of 1/2/5Mbps can be delivered to a large proportion of locations (99%, 90% and 60% respectively). An 800MHz network operating under the same load conditions has only marginal advantages;
- 2x15MHz of 1800MHz can serve more locations than 2x10MHz of 800MHz for the same loading ─ the benefit of 1800MHz is between 10 to 18% points gain in locations served;
- 2x15MHz of 1800MHz can serve more locations and sustain more users than 2x10MHz of 800MHz ─ the benefit of 2x15MHz at 1800MHz is between 11 to 17% points gain in locations served.

The data from Ofcom strongly suggests that LTE networks operating with either 2x10MHz of 800MHz or 2x15MHz at 1800MHz can be credible competitors in terms of coverage, speed and capacity and that a network operating at 2x15MHz at 1800MHz has some advantages in terms of capacity.

Is additional 2.6GHz spectrum required?

Despite the analysis above Ofcom opts for a proposed reservation of spectrum in the medium portfolios. The fourth operator is assumed to require 2.6GHz spectrum for capacity to be a credible competitor. We construct a simple model below to show that spectrum in the smaller portfolios augmented by either minimal (or manageable) site build in future years yields

a network of sufficient capacity under reasonable demand forecasts for a network with current access to 3G spectrum.[40]

The steps in our analysis are as follows:

1. Collect busy hour (BH) HSDPA traffic volumes from 3G cell carriers[41] on the Vodafone network during the busy hour on 22nd February 2012. This will, we believe, be representative of how data traffic is distributed across cells in any of the UK networks.

2. Apply an annual compound growth rate of 63% to the traffic data; this is the mid point of the lower and upper bounds of the annual growth rates which Ofcom presents in Annex 6 paragraph 3.18.

3. Calculate the resulting traffic volumes at annual intervals ─ the results presented here are for 5, 7 and 10 years.

4. For each year we assess whether the resulting traffic can be accommodated by a single HSPA+ carrier operating MIMO technology (peak rate of 28.8Mbps). Our assumption is that cells which are capacity constrained are in the densest parts of the network and that the traffic is typically relatively close to the site. The cell throughput is assumed to average 10Mbps in the busy hour; we also explore the case where the average cell throughput is 5Mbps (this characterises the throughput achieved at the mid cell point). [Confidential].

5. We then estimate the excess traffic which cannot be accommodated by the single HSPA+ carrier and calculate whether it can be accommodated by a 2x15MHz LTE carrier. This carrier is assumed to be capable of providing an average throughput of 72Mbps in the busy hour whilst mainly serving traffic relatively close to the site; we also examine the case where the cell is able to sustain 37Mbps. [Confidential]..

6. The final step is to assess the volume of excess traffic which cannot be carried by the 2x15MHz LTE carrier. We then make a simple estimation of the number of additional sites required to carry any excess traffic not served by the combined HSPA+ and 2x15MHz LTE carriers.

The chart below shows how HSDPA traffic was distributed amongst the cells in the 3G network on the busy hour which occurred on the 22nd Feb 2012.

[Confidential].

[40] For a network with no customers spectrum in the smaller portfolios is obviously sufficient.
[41] A 3G cell carrier is defined as a single 5MHz carrier operating in a single sector of a 3 sector site.

The BH traffic is then grown at a rate of 63% per annum and each cell is assessed to see if the offered traffic can be accommodated by a HSPA+ and LTE carrier. The table below tabulates the results of this exercise for 5, 7 and 10 years.

	Lower bound capacity assumptions		Upper bound capacity assumptions	
Years	% of sites where HSPA+ capacity is insufficient	% of sites where LTE capacity is not sufficient	% of sites where HSPA+ capacity is insufficient	% of sites where LTE capacity is not sufficient
5	13.11%	0.02%	3.41%	0%
7	27.83%	0.96%	19.81%	0.08%
10	49.93%	19.81%	40.56%	6.25%

Our analysis shows that after 10 years with the lower bound capacity assumptions 19.81% of cells would no longer be able carry all of the offered traffic, this reduces to 6.25% for the upper bound capacity assumptions. The amount of excess traffic is shown in the table below.

	Lower bound capacity assumptions	Upper bound capacity assumptions
Busy Hour Excess traffic (PByte)	143	67
Additional sites	2042	509

In a mobile network additional sites or alternative technologies would be deployed to handle the excess traffic. In order to estimate the amount of additional sites required we have assumed that each site has a maximum traffic carrying capability equal to nine HSPA+ carriers and three 2x15MHz LTE carriers. We have examined the case where the sites have the traffic carrying capability equal to the lower and upper bound assumptions outlined above. Using this method our estimate is that between 500 and 2,050 sites would be required after 10 years. These estimates increase to between 1,650 and 3,500 additional sites for a network with access to the 2x10MHz at 800MHz portfolio.

Our analysis shows that, under plausible demand conditions, a network with access to the smaller reserved spectrum portfolios has sufficient network capacity to be a credible competitor provided the existing site count is augmented with minimal (or manageable) additional build over a 10 year period i.e., an average minimum of 50 and a average maximum of 350 additional sites per annum (recall that Ofcom assumes that an operator can build 1.5k sites per annum). This simple analysis adds weight to our view that a fourth operator with access to spectrum in the smaller portfolio has adequate spectrum to compete in terms of coverage, speed and capacity.

Min Var v Max Var

Ofcom has recognised that there are still major areas of uncertainty in its modelling. Ofcom has introduced the concept of a "Min Var" set of assumptions, which Ofcom believes will give the least variation across the scenarios considered in the consultation, and a "Max Var" set of assumptions, which will give the most variation. These sets of assumptions cover four parameters – SINR cut-off, median building penetration loss, associated building penetration loss standard deviation and scheduling algorithm.

Vodafone does not believe that either the SINR cut-off or scheduling algorithm assumptions made by Ofcom significantly affect the frequency dependence of the published results. The assumptions about building penetration loss, however, do have a significant effect and merit closer examination. A detailed discussion of Ofcom's assumptions for median building penetration loss and associated standard deviation follows below.

Ofcom has recognised that there is significant uncertainty with respect to building penetration losses, due the large number of diverse buildings that exist within the UK's building stock and the limited number of measurement studies available (most of which do not consider UK residential housing). Hence Ofcom has introduced two scenarios in their latest consultation, which it considers represent the upper and lower bounds of possible values. The values are shown in Table 1 below, along with the assumptions used for the March 2011 consultation.

		Assumed Median Building Penetration Loss (dB)								
		800 MHz			1800 MHz			2600 MHz		
	Depth (m)	Lower Bound	March 2011	Upper Bound	Lower Bound	March 2011	Upper Bound	Lower Bound	March 2011	Upper Bound
Dense Urban	1	4.5	N/A	9.0	4.5	N/A	11.0	4.5	N/A	11.3
	5	5.8	N/A	11.6	5.8	N/A	15.5	5.8	N/A	16.2
	10	7.4	11.2	14.9	7.4	13.3	21.2	7.4	15.0	22.4
	15	9.1	13.6	18.1	9.1	18.8	26.9	9.1	23.1	28.5
Urban	1	3.2	N/A	6.4	3.2	N/A	8.3	3.2	N/A	9.2
	5	4.5	N/A	8.9	4.5	N/A	12.8	4.5	N/A	14.6
	10	6.1	9.2	12.2	6.1	11.3	18.5	6.1	13.0	21.4
	15	7.7	11.6	15.5	7.7	16.8	24.2	7.7	21.1	28.2
Suburban / Rural	1	1.8	N/A	3.7	1.8	N/A	5.6	1.8	N/A	6.5
	5	3.2	N/A	6.3	3.2	N/A	10.2	3.2	N/A	11.9
	10	4.8	7.2	9.6	4.8	9.3	15.9	4.8	11.0	18.7

	15	6.4	9.6	12.8	6.4	14.8	21.5	6.4	19.1	25.5

Table 1: Comparison of the March 2011 BPL Assumptions with the Upper and Lower Bound Assumptions

The March 2011 assumptions lie reasonably centrally between the upper and lower bound assumptions, suggesting that Ofcom still views these original assumptions to be the most likely scenario. However, as Vodafone showed in our previous response the frequency dependence implied by these assumptions exceeds most values that have been published in the literature. Introducing an upper bound scenario implies an even higher frequency dependence exponent than the March 2011 assumptions. This can be seen if we compare the frequency exponents that are implied by the various assumptions.

Depth (m)	BPL Frequency Exponent (dB/decade)					
	Between 800 and 1800 MHz			Between 800 and 2600 MHz		
	Lower Bound	March 2011	Upper Bound	Lower Bound	March 2011	Upper Bound
1	0.0	N/A	5.5	0.0	N/A	5.5
5	0.0	N/A	10.9	0.0	N/A	10.9
10	0.0	6.0	18.0	0.0	10.8	18.0
15	0.0	14.8	24.8	0.0	18.6	24.8

Table 2: Comparison of the March 2011 BPL Frequency Dependence Assumptions with the Upper and Lower Bound Assumptions

Hence the frequency exponents now considered by Ofcom vary from 0dB/decade up to 24.8dB/decade (which exceeds, for many scenarios, the frequency exponent of the propagation loss itself as defined by the Extended Hata model). Vodafone recognises that the Building Penetration Loss (BPL) does indeed have some dependency on frequency, but we consider that the March 2011 assumptions were themselves an over-estimate of this dependence. The new upper bound considered by Ofcom increases this over-estimate.

Some of the building penetration loss frequency exponents that have been reported in the literature are considered in Figure 1 below:

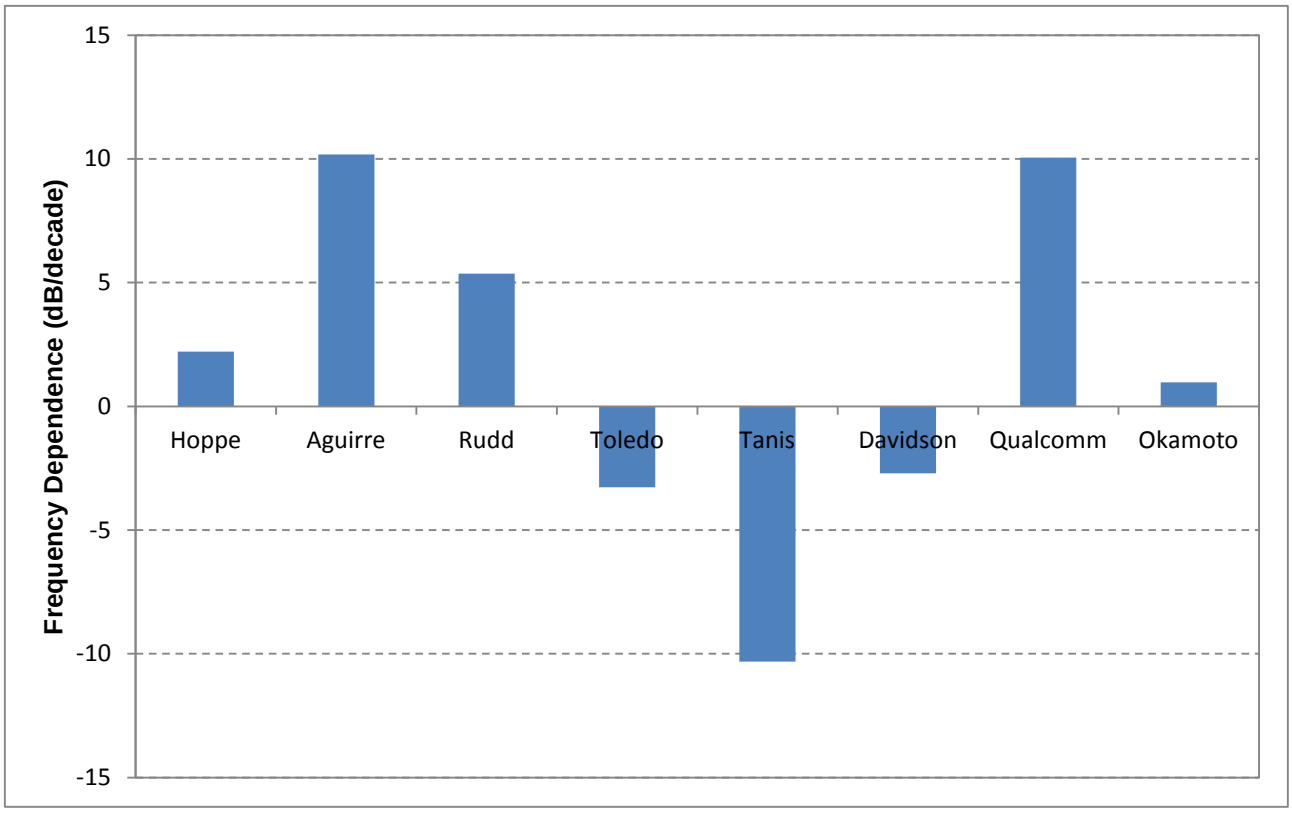

Figure 1 : BPL Frequency Exponents Reported in the Literature

The sources of this data are:

- R. Hoppe et al. “Measurement of Building Penetration Loss and Propagation Models for Radio Transmission into Buildings”, IEEE Vehicular Technology Conference, VTC Fall 1999.
- S. Aguirre et al. “Radio Propagation into Buildings at 912, 1920, and 5990 MHz Using Microcells”, IEEE 3rd Annual International Conference on Universal Personal Communications, 1994.
- R.F. Rudd, “Building Penetration Loss for Slant-Paths at L-, S- And C-Band”, IEE 12th International Conference on Antennas and Propagation, ICAP 2003.
- Okamoto H., Kitao K. & Ichitsubo S., “Outdoor-to-Indoor Propagation Loss Prediction in 800-MHz to 8-GHz Band for an Urban Area”, IEEE Transactions On Vehicular Technology, Vol. 58, No. 3, March 2009.
- “Optimization of the 900 MHz Spectrum for 3G use”, Qualcomm, from Deploying UMTS900 Conference, March 2008.
- A.F. Toledo et al., “Propagation into and within buildings at 900, 1800 and 2300 MHz”, IEEE 42nd Vehicular Technology Conference, 1992.
- W.J. Tanis et al. "Building penetration characteristics of 880 MHz and 1922 MHz radio waves”, IEEE 43rd Vehicular Technology Conference, 1993.
- Davidson et al., Measurement of Building Penetration into Medium Buildings at 900 and 1500 MHz”, IEEE Transactions On Vehicular Technology, Vol. 46, No. 1, February 1997.

None of the reported frequency exponents exceed 10dB/decade with the average value being around 1.6dB/decade. These figures are much lower than Ofcom's upper bound assumptions. However, we recognise that Ofcom considers different BPLs at different depths of penetration, with deeper penetrations having a higher frequency exponent, whereas the above figures are usually for a mix of penetration depths, if this is documented at all.

There has been very little research on the relationship between the frequency exponent and the depth of penetration. One source that did consider this is the paper by Okomato et al referred to above, with the relevant results shown in Figure 4 of that paper. It can be seen that any divergent trend between the results for 812MHz and 2200MHz is negligible after a few metres. Even considering this initial divergence, Figure 5 of the same paper shows that, for office buildings, the penetration distance co-efficient parameter (equivalent to the specific attenuation rate parameter, α_{di}, used in Ofcom's own model) only varies from around 0.52dB/m at 821MHz up to around 0.68dB/m at 2200MHz, and is relatively constant thereafter. This is equivalent to an additional frequency exponent of only 0.37dB/decade/m, or 5.5dB/decade at 15m, which is not enough to explain the figures that have been adopted by Ofcom for their upper bound assumptions, even in the unlikely case that every study considered in Figure 1 above only considered measurements at shallow penetration depths.

We therefore suggest that there is no publicly available measurement data that supports the upper bound building penetration loss assumptions that are being used by Ofcom. Vodafone believes that the true situation is much closer to the lower bound assumptions.

Ofcom also recognises the uncertainty that exists around the standard deviation of the building penetration loss, and thus also considers lower bound (Min Var) and upper bound (Max Var) assumptions. The assumed values are listed below, along with the March 2011 assumptions:

Depth (m)	BPL Standard Deviation (dB)								
	800 MHz			1800 MHz			2600 MHz		
	Lower Bound	March 2011	Upper Bound	Lower Bound	March 2011	Upper Bound	Lower Bound	March 2011	Upper Bound
1	4.0	N/A	8.0	5.4	N/A	10.8	6.0	N/A	12.0
5	4.0	N/A	8.0	5.4	N/A	10.8	6.0	N/A	12.0
10	4.0	6.0	8.0	5.4	6.0	10.8	6.0	6.0	12.0
15	4.0	7.0	8.0	5.4	9.0	10.8	6.0	9.0	12.0

Table 3: Comparison of the March 2011 BPL Standard Deviation Assumptions with the Upper and Lower Bound Assumptions

Ofcom now assumes that the BPL standard deviation is independent of penetration depth, and has a strong frequency dependence of between 3.9dB/decade (lower bound) and 7.8dB/decade (upper bound). These revised assumptions prompt examination of two aspects:

- The upper bound standard deviation is now very large, particularly for low penetration depths. This implies that Ofcom believes that there is a significant probability of a negative building penetration loss (i.e. signal strength gain).
- The frequency dependence of the BPL standard deviation is now assumed to be much higher than it was in the March 2011 consultation.

The issue of negative building penetration gains was raised by Vodafone in our response to the March 2011 consultation, where we stated that the probability that this would occur is, in practice, very low. Ofcom responded that recent IEEE publications by Ferreira et al 1 and Plets et al 2 show that negative attenuation gains are a real possibility. And indeed, this is what these papers show. The paper by Ferreira, for example, shows a remarkable 28% probability of a building penetration gain for “Light Indoor” rooms and 17% for “Deep Indoor” rooms. How can buildings have such a beneficial gain on signal propagation?

The answer can be found in the papers themselves where it is stated that, in common with many other studies of this type, building penetration losses are measured relative to a reference value measured outside the building near ground level. Studies that use this methodology (which is understandable, given the practical difficulties in measuring signal strength outside rooms on upper floors) are thus attempting to quantify two competing effects:

- The signal strength loss due to penetration of the signal into the building
- The signal strength gain due to receiving the signal at a greater height

When the height gain outweighs the penetration loss negative building penetration losses may be observed, but this is usually because the reception point is higher than the reference point, rather than because the reception

point is inside a building whereas the reference point is outside. The effect of this measurement methodology will be to increase the observed standard deviation of the measurements, as the measurements made on different floors will be clustered around different median points.

It is not clear whether Ofcom intended to model the building penetration loss and height gain using a single random variable in this way. The stated assumptions note that the assumed mobile antenna height is 1.5m above ground level, suggesting an assumption that the user is on the ground floor of the building, but this aspect of the modelling is not otherwise discussed. Clearly, if the intended assumption was that the user is located on the ground floor, then using data from papers such as 1 and 2 will tend to overestimate the BPL standard deviation. On the other hand, if the intention was to model users located on an arbitrary floor within the building, then it is inappropriate to use models calibrated by buildings which have more floors – in some cases, many more floors – than the one or two floors that are typical of the UK's domestic housing stock. It would be far better to model the two effects separately; particularly as the height gain can be modelled directly using the Extended Hata propagation model.

This modelling error also explains why Ofcom finds the frequency dependence of the BPL standard deviation to be so high. Examining the Extended Hata model, we can see that it is the height gain itself that is frequency dependent. The relevant term from the propagation loss equation is given below for antenna heights up to 10m:

$$a(H_m) = \left(1.1 \cdot \log_{10}(f) - 0.7\right) \cdot \min\{10, H_m\} - \left(1.56 \cdot \log_{10}(f) - 0.8\right) + \max\left\{0, 20 \cdot \log_{10}(H_m/10)\right\}$$

where Hm is the mobile antenna height. For antenna heights up to 10m, the frequency exponent of the mobile antenna height gain is given by 1.1·Hm – 1.56dB/decade, and above 10m, it is fixed at 9.44dB/decade (in fact, the components of the Extended Hata model were never calibrated for mobile antenna heights above 10m so it is unlikely that the transition to a constant value is so abrupt). Hence it can be seen that the frequency dependence of the mobile antenna height gain is sufficient to explain the frequency dependence of the BPL standard deviation assumed by Ofcom.

Hence we must conclude that magnitude and frequency dependence of the upper bound assumptions that Ofcom has made regarding the BPL standard deviation result from a reliance on statistics which combine building penetration loss and mobile antenna height gain into a single random variable. It has been shown that this is inappropriate, as these statistics are usually collected from buildings that have more floors than typical UK residential housing. Vodafone believes that Ofcom should separate the modelling of the two effects using the Extended Hata model to model mobile antenna height gain and appropriately calibrated statistics to model the building penetration loss standard deviation. Vodafone believes that these

revised statistics would be closer to, and maybe lower than, Ofcom's current lower bound assumptions.

References

1. Ferreira L., Kuipers M., Rodrigues C. and Correia L.M., "Characterisation of Signal Penetration into Buildings for GSM and UMTS", 3rd International Symposium on Wireless Communication Systems, Sept. 2006, pp. 63 – 67.
2. Plets D., Joseph W., Veerloock L., Tanghe E., Martens L., Deventer E. and Gauderis H., "Influence of Building Type on Penetration Loss in UHF Band for 100 Buildings in Flanders", Antennas and Propagation Society International Symposium, 2008, AP-S 2008, pp. 1 – 4, IEEE.

Error in Ofcom's Implementation of the Extended Hata Model

Ofcom has adopted the Extended Hata model, as defined by CEPT [3] for use in their analysis of the relative merits of the 800, 1800 and 2600MHz bands. The Matlab implementation of this model was published in [4]. The relevant file is Extended Hata.m and the pathloss for the urban clutter type has been implemented as follows:

```
if frequency <= 150
       Lurban = 69.6 + (26.2 * log10(150)) - (20 * log10(150 / frequency)) + Beta - a - b;
elseif frequency <= 1500
       Lurban = 69.6 + (26.2 * log10(frequency)) + Beta - a - b;
elseif frequency <= 2000
       Lurban = 46.3 + (33.9 * log10(frequency)) + Beta - a - b;
elseif frequency <= 3000
      Lurban = 46.3 + (33.9 * log10(frequency)) + (10 * log10(frequency / 2000)) + Beta-a-b;
end
```

where Beta, a and b are terms computed prior to this calculation. Unfortunately, the implementation of Lurban for frequencies between 2000 and 3000 MHz does not match the definition in [4] which is effectively:

```
Lurban = 46.3 + (33.9 * log10(2000)) + (10 * log10(frequency /
                    2000)) + Beta - a - b;
```

Note that the second term is a constant independent of frequency, rather than being dependent on frequency as in the Ofcom implementation. The net result of this error is that propagation losses are overestimated by Ofcom by a factor of:

```
(33.9 * log10(frequency)) - (33.9 * log10(2000))
```

At 2.6GHz, this factor will be a 3.9dB overestimate of pathloss. This error applies to all clutter types, as the pathloss for the other clutter types is defined as an offset from the urban case. For a given link budget, this error will lead Ofcom to underestimate cell radii at this frequency. The effect of this can be estimated by analysing the distance dependent term of the Extended Hata equation. This is defined in [4] and implemented by Ofcom as follows:

```
Beta = ((44.9 - (6.55 * log10(max(30, height_tx)))) .*
(log10(distance) .^ Alpha)) - (13.82 * log10(max(30,
height_tx)));
```

where Alpha is also a distance dependent term, but is equal to unity for distances less than 20km. For base-station antenna heights of up to 30m and ranges less than 20 km, Beta thus reduces to:

```
Beta = 35.2 .* log10(distance) – 20.4;
```

Hence, when expressed in linear terms, the Extended Hata equation predicts that the pathloss is proportional to distance raised to the power of a constant which, for the above assumptions, is equal to 3.52. In other words:

$$L = k \cdot d^{3.52}$$

where L is the linear pathloss and k is a distance independent constant. If we consider the effect of a 3.9 dB error on the predicted cell radius, we get:

$$\left(\frac{d_1}{d_2}\right) = \left(\frac{L_1}{L_2}\right)^{1/3.52}$$

or, considering cell area, we get:

$$\left(\frac{d_1}{d_2}\right)^2 = \left(\frac{L_1}{L_2}\right)^{2/3.52}$$

For a 3.9dB overestimate in pathloss, equivalent to a factor of 2.45, it can be seen that the cell area will be underestimated by a factor of 1.67, equivalent to some 60 % of the actual cell size as predicted by the Extended Hata model. This, of course, will only be the case for noise limited cells. For interference limited cells, the underestimate of cell area will be somewhat less than this. Hence the only way to quantify the effect of this error on Ofcom's published results is for Ofcom to re-run their simulations using a corrected implementation of the Extended Hata model.

References

[3] http://tractool.seamcat.org/raw-attachment/wiki/Manual/PropagationModels/ExtendedHata/Hata-and-Hata-SRD-implementation_v2.pdf

[4] http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/annexes/matlab-annex14.zip

Legal Analysis

Justification for Regulatory Intervention – Deficiencies in Ofcom's ex ante Competition Analysis

Vodafone welcomes Ofcom's *de facto* recognition that the reasoning underlying its concerns about the proposed auction leading to a reduction in the number of infrastructure operators in the UK mobile market is insufficient to justify its intervention in the way in which additional spectrum is to be sold. Unfortunately, the additional justification now provided by Ofcom in its supporting annexures fails to bolster the arguments that it has previously adduced and, in essence, amounts to little more than speculation.

The speculative nature of Ofcom's arguments about the potential harm to competition and consumers resulting from a reduction in the number of infrastructure operators goes to the credibility and reliability of these arguments. Given the consequences for the design of the auction flowing from Ofcom's concerns about the potential lessening in competition with a reduced number of infrastructure operators on prospective basis, the burden that Ofcom must discharge when reaching its conclusions is a high one.

In this respect, Vodafone finds it disappointing that Ofcom seeks to quibble with Vodafone's analysis of the legal test that Ofcom must satisfy when undertaking what is to all intents and purposes an *ex ante* analysis of the relevant wholesale and retail mobile markets. The legal test is clearly stipulated in what remains the leading case for the review of a merger (which by its nature is prospective). That case makes clear the standard to be discharged in a prospective analysis is, on any objective view, a high one.[42] If Ofcom intends to employ some of the tools typically adopted by a competition authority when assessing the impact of a merger, then it must be accept that it is subject to the obligations that apply to a competition authority engaged in such a task.

None of Ofcom's selective quotations from the dicta of the Competition Appeal Tribunal alter the effect of the jurisprudence of the Community courts in relation to the conduct of an ex ante analysis. Indeed, had Ofcom examined and cited the full relevant text of the judgment of the Tribunal upon which it seeks to rely for its own view of the legal test, it would have noted that the judgment in question provides clear authority for Vodafone's assessment of the relevant legal test:

> *"4.23 This does not mean that because there is ex ante analysis that the Respondent [i.e. the regulator] has to meet a higher standard of proof. The standard is whether, on the balance of probabilities an undertaking has*

[42] *Commission of the European Communities v.Tetra Laval BV,* (Case C-12/03P)

> *significant market power. Rather the Panel is merely asserting the common sense proposition that when one is making a finding of significant market power on the basis of a prospective analysis (as opposed to an ex post analysis) then it is necessary that this analysis be sufficiently rigorous and thorough so that a clear link can be drawn between existing circumstances and likely future behaviour. To put it another way, because the likelihood of error is greater in a prospective analysis, the prospective analysis must be proportionately more rigorous to account for this possibility."*
>
> *We [the Tribunal] respectfully agree with that approach."*[43]

Given that Ofcom is seeking to interfere in an auction process that would otherwise be determined according to market forces, it is incumbent upon Ofcom to ensure that its reasoning and conclusions are sufficiently rigorous and robust. The burden upon it, in practical terms, is therefore a high one.

In light of the above, Ofcom's attempt to define an alternative legal test for the type of analysis in which it is engaged in this situation is clearly not appropriate. Whether it wishes to use the adjective "high" or "rigorous" in connection with the burden or duty with which it as the NRA is entrusted is little more than an exercise in semantics. The final word resides with the more general guidance of the Tribunal as to the expectation upon Ofcom in undertaking its duties as regulator:

> *"It is the duty of a responsible regulator to ensure that the important decisions it takes, with potentially wide ranging impact on industry, should be sufficiently convincing to withstand industry, public and judicial scrutiny."*[44]

Regrettably, the additional justifications that Ofcom now provides for its concerns about the reduction in the number of infrastructure operators in the UK would fail to satisfy the test, as articulated by the Tribunal.

In essence, Ofcom advances two theories of harm that a competition authority might apply in the conduct of a merger review to support. These are:

i. the scope for the market post-merger to give rise to so-called unilateral effects;

ii. the scope for the market post-merger to give rise to a risk of tacit collusion.

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[43] *Hutchison 3G UK Limited v Ofcom* [2005] CAT 39, paragraph 33, citing and endorsing Decision No: 02/05 of the Electronic Communications Appeals Panel in respect of appeal No: ECAP 2004/01

[44] *Vodafone v Ofcom* [2008] CAT 22, paragraph 47

Whilst such theories are plainly relevant to an ex ante merger analysis, as the aforementioned case law confirms, any competent authority would need to adduce clear evidence to support its findings that the market post-merger would give rise to either of these effects. In this case, Ofcom's analysis is notable for the paucity of the evidence indicating that such outcomes might be realised if there were to be a reduction in the number of infrastructure operators. As such, these concerns constitute little more than unsubstantiated assertions.

Unilateral effects

In relation to unilateral effects, critically Ofcom fails to assess the existing state of competition, which has a direct bearing on any unilateral effects analysis whether on the wholesale or retail access markets. In simple terms, the need to acquire market share in such competitive market conditions would mean that a mobile operator would typically wish to invest in its network (whether in terms of rollout or capacity or services) since it will plainly be concerned that not to do so would enable a rival to acquire additional share at its expense. Ofcom's analysis fails to take this into account and specifically fails to examine the extent of differentiation between mobile operators and their ability to add capacity or invest in their network should they consider this to be necessary. Where a mobile operator faces no such constraint, it is clearly more likely in a competitive market that it will seek to undercut its rivals.

The same analysis is relevant to the application of the unilateral effects theory to the wholesale access market. In a competitive market with the ability of each mobile operator to supplement capacity and improve its network quality (both of which are key parameters of competition on this market), each mobile operator's behaviour would be affected by its concern about the ability of wholesale access partner to switch to a rival that had chosen to commit to additional investment in its network. Given that switching is plainly possible and does occur on the wholesale access market, the potential loss of a partner (with the associated wholesale revenues that would be generated by that partner) would have an obvious impact on the strategy of the wholesale access provider. Once again, Ofcom's assessment fails to take these factors into account.

Tacit collusion

Ofcom's conclusions in relation to the scope for a reduction in the number of infrastructure providers to give rise to tacit collusion are also conspicuous for the absence of the rigorous analysis that should underpin such a finding.
The criteria that must be satisfied for a finding that a market is susceptible to tacit co-ordination have been clearly established and consolidated by the Community Courts, most famously in the *Airtours* case a decade ago.[45] These are:

[45] Case T-342/99, *Airtours plc v Commission* [2002]

i. the need for transparency in the relevant market to establish a focal point and to enable a firm to monitor whether or not there has been deviation on the part of a rival;

ii. the potential for a retaliatory mechanism to create a disincentive for any departure from the co-ordinated outcome;

iii. the absence of countervailing constraint from competitors or customers that would undermine the potential for co-ordination.

The Court of First Instance specifically noted that it was necessary for the European Commission to provide "convincing evidence" that the above criteria are likely to be satisfied.[46] If this test were to be applied to the analysis in Ofcom's current consultation document, then it becomes clear that Ofcom's forecasts in relation to the prospects for collusion in relation to a number of parameters of competition, following the reduction in the number of mobile operators in the UK market, are simply unsustainable.

Ofcom proposes that co-ordination might arise in a number of different ways, including:

- retail pricing;
- competing to acquire customers from each other;
- delay to the introduction of new services or investment in networks;
- setting wholesale prices to inhibit competition from wholesale access seekers on the retail mobile market.

Taking each of these alleged areas of potential co-ordination in turn, the most cursory of review of Ofcom's analysis that it has failed consistently to apply effectively the criteria laid down by the CFI. Consequently, its claims remain unfounded and therefore unreliable.

The starting point for any analysis of tacit collusion is the extent to which current market conditions make such collusion feasible. In this respect, transparency is critical to any finding of tacit collusion. Ofcom is forced to concede in relation to mobile tariffs (prices) that currently there is a high degree of complexity and variation in the way that tariffs are structured and sold to mobile consumers. Importantly, the real price that a mobile operator charges is masked by a number of factors, most notably, the usage and traffic profiles of different consumer segments of each mobile operator. These factors or data will not be disclosed by one competitor to another. To do so or even to disclose future pricing intentions would plainly raise concerns under Article 101 of the EC Treaty or Chapter I of the UK Competition Act. The transparency needed to establish a focal point and to enable monitoring

[46] Case T-342/99, *Airtours plc v Commission* [2002] paragraph 63

between competitors simply does not exist. How this state of affairs would be so dramatically altered is a question that is simply not addressed by Ofcom's consultation.

Similar considerations arise in relation to Ofcom's claims about the scope for co-ordination to arise through less aggressive acquisition activity and the failure to launch new services. Once again, Ofcom's analysis fails to take into account that there are a number of ways in which mobile operators compete to acquire one another's subscribers, which are not visible on the relevant market. One of the most important of these parameters, the level of subsidy for handsets or commissions for indirect channels, is highly sensitive and not shared by competitors. Once again, were such information to be made available, concerns about *explicit* collusion would arise under competition law. Similarly, it is difficult to understand how collusion might arise in relation to the launch of future services when confidentiality is maintained until the new product or service is launched and made public. It is therefore difficult to see how an agreement might be reached in such conditions.

The lack of transparency in the wholesale access market is a factor that Ofcom has also neglected to investigate to any level of detail. Had Ofcom examined the actual evidence from the wholesale access market, it would have established the scope for co-ordination in respect of access terms that would prevent wholesale access seekers from driving competition on the retail market is non-existent. This is because terms for wholesale seekers will vary enormously by dint of the fact that wholesale access seekers will wish to pursue different strategies according to their commercial model, which correspondingly shapes the way in which their wholesale terms might be determined. These terms are therefore bespoke to the requirements of each wholesale access seeker and will remain confidential even after the conclusion of an agreement.

Ofcom's argument about the potential impact on competition of a reduction in the number of mobile operators thus rests solely on an increase in the level of concentration in the market that arises if one party were to exit the market. But an increase in the level of concentration does not axiomatically lead to a conclusion that a market will be susceptible to co-ordination. This is because it is necessary to examine more closely the dynamics and structure of the market. Indeed, the European Commission's guidelines issued to NRAs in relation to prospective market reviews explicitly restates the position of the Community Courts about the extent of any inference that can be drawn from concentration in a market:

> *"It must be stressed that a mere finding that a market is concentrated does not necessarily warrant a finding that its structure is conducive to collective dominance in the form of tacit coordination."* [47]

[47] Commission guidelines on market analysis and the assessment of significant market power under

Thus, Vodafone's concern about the dearth of evidence in support of Ofcom's arguments about the intensity of competition following a reduction in the number of infrastructure operators – as articulated in its response to Ofcom's previous consultation – has not been fundamentally addressed by any substantive argument in this consultation. Indeed, the available evidence from the relevant wholesale and retail markets, which has not been taken into account, clearly calls into question the validity of Ofcom's concerns. In circumstances where Ofcom is simply unable to adduce credible evidence to substantiate its concerns about the impact on competition with fewer mobile infrastructure operators, the case for regulatory intervention in the process for the sale of additional spectrum has not been made out.

Proportionality Arguments for the Reservation of a 2.6GHz block for a fourth MNO.

The principle of proportionality

If, contrary to Vodafone's primary case, Ofcom is able to demonstrate that there is a compelling justification for the reservation of a tranche of spectrum for H3G or a new entrant, it must still ensure that any regulatory intervention is compatible with the principle of proportionality.

This obligation is relevant where Ofcom is proposing a particularly intrusive form of intervention to shape the outcome of a bidding process that would otherwise be open and freely determined, resulting in the assets being in the hands who value it most. Regulatory intervention must therefore not lead to an inefficient outcome that would adversely impact the intensity of competition and consequently the position of mobile consumers. As noted in our submission, such an outcome might arise where a bidder for the reserved spectrum acquired spectrum in excess of its requirements and did not wish to invest in the exploitation of that additional spectrum. Were this outcome to be realised, Ofcom's approach would be incompatible not only with the principle of proportionality, but with its duties to manage and allocate radio spectrum in an effective way that furthers the interests of competition and consumers.

Accordingly, the central issue is the extent to which Ofcom is able to demonstrate that its intervention does not go beyond what is necessary to achieve its objective of preserving the current market structure. This is the principle of proportionality, which is enshrined in Community law, one that governs the conduct of Member States:

> *"The Court has consistently held that the principle of proportionality is one of the general principles of*

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the Community regulatory framework for electronic communications networks and services [2002] OJ C 165/6, paragraph 100. Paragraphs 101-102 go on to explain reasons, with real world examples, why concentrated markets do not result necessarily in findings that these markets are conducive to tacit co-ordination.

> *Community law. By virtue of that principle, the lawfulness of the prohibition of an economic activity is subject to the condition that the prohibitory measures are appropriate and necessary in order to achieve the objectives legitimately pursued by the legislation in question; when there is a choice between several appropriate measures recourse must be had to the least onerous, and the disadvantages caused must not be disproportionate to the aims pursued."*[48]

This general obligation under Community law has been reinforced by Parliament, which has imposed a duty upon Ofcom in the enactment of the Communications Act to ensure that it must have regard to the principle of proportionality when performing its duties.[49]

When considering the meaning and application of this statutory obligation, the Competition Appeal Tribunal has held that it should be interpreted in a manner identical to that under Community law:

> *"The principle of proportionality requires that any action by OFCOM shall not go beyond what is appropriate and reasonably necessary to achieve their stated objectives. Also, where a choice exists between equally effective measures that might be adopted to address a problem, recourse should be had to the least onerous measure that will achieve the stated aims."*[50]

For the reasons that we outline below, Ofcom's proposed course of action in relation to the portfolio needed by a fourth mobile operator is not consistent with the aforementioned legal framework mandated by both the Community and UK courts.

The reservation of the additional 2.6GHz block is not proportionate

In deciding the extent of any reservation of spectrum, Ofcom must establish how much spectrum would be needed by a fourth operator to deploy an LTE network that would enable it to be a credible competitor. As is discussed earlier in this submission, it is not necessary for Ofcom to ensure, via a reservation of spectrum, that the fourth operator is able to match its rivals on every conceivable parameter of competition. Ofcom itself recognises the force in this line of argument, noting that "*a national wholesaler can be a credible competitor at national wholesale level even if it is disadvantaged in some areas* [of competition] *relative to others."*[51] In the practical application of the principle of proportionality, the critical issue to be determined by the regulator

[48] Case C-331/88, *R v Minister of Agriculture and Secretary of State for Health ex parte Fedesa and others*, paragraph 13
[49] Communications Act 2003, section 3(3)(a)
[50] *Vodafone v Ofcom* [2008] CAT 22, paragraph 51
[51] Consultation document, paragraph 4.100

is the minimum amount of spectrum required to enable a fourth operator to deploy an LTE network that enables it, in the round, to be a viable competitor on relevant wholesale and retail access markets.

In this case, Ofcom has proposed that the minimum necessary to enable the creation of a credible LTE operator is a holding in either the 800MHz or 1800MHz (2x15MHz) bands in conjunction with a holding in the 2.6GHz band. However, this is plainly at odds with previous findings in relation to the amount of spectrum that is necessary to create a credible LTE operator. Accordingly, Ofcom must be able to demonstrate that its proposed course of action is capable of being reconciled with these previous findings to ensure that this course of action is in fact consistent with the principle of proportionality.

The amount of spectrum necessary to create a credible LTE operator was the central issue that fell to be considered by the European Commission in its review of the proposed merger of T-Mobile UK and Orange UK in 2010. This was, of course, a process in which Ofcom as the UK national regulator was involved. As the Commission's merger decision reveals, the concentration of spectrum in the hands of the merged entity left it in a position where it was able to launch an LTE network. With no other mobile operator in possession of sufficient spectrum to launch such a network, the Commission needed to assess and determine the appropriate remedy to preserve effective competition to EE post-merger. Following discussions with the merging parties, it identified that a divestment of 2x15MHz block in the 1800MHz band would be sufficient to enable the creation of a credible rival to any LTE network that might be deployed by the merging parties.

In this respect, the Commission noted emphatically that a divestment of a larger block of spectrum was not necessary to create effective competition even though the spectrum to be divested by EE (2x15MHz) was not as large as the amount of spectrum available to the merged entity (2x20MHz):

> *"In any case, the Commission considers that a divestiture of 2x20 MHz of spectrum would go beyond what is necessary to address the competition concerns which emerged during the investigation…It is therefore reasonable to conclude that the divestment of 2x15 MHz of 1800 MHz spectrum would be a better solution and still sufficiently clear-cut to address the competition concerns: by acquiring such amount of spectrum, O2 or Vodafone could develop independently a 2x15 MHz or even a 2x20 MHz network that could effectively compete with the JV's network on equal grounds."*

It is plain on the face of the wording of the Commission's decision that it had applied the principle of proportionality to determine how to address its concerns about the impact of the merger on future competition. A divestment of 2x20MHz would clearly place any potential purchaser on the exact same footing as EE. But, as the Commission recognised when intervening in a

commercial transaction, it is necessary to undertake a balancing exercise to determine the necessary limit on regulatory intervention. Ofcom's current approach to the bidding process for the acquisition of spectrum is conspicuous for the absence of such a meaningful balancing exercise.

Equally significantly, the Commission did not find that it was necessary to hold existing spectrum in the 1800MHz band or *any other spectrum* in order for the divestment to achieve its objective of creating a credible rival to EE. Indeed, its conclusion in this regard was unambiguous:

> *"Alternatively, 3UK or a new entrant would also have sufficient spectrum of 1800 MHz to build a strong competing LTE network… the Divestment Spectrum will be sufficient for any potential purchaser to deploy an LTE network, irrespective of whether it would be contiguous to its own existing 1800 MHz band or not. Indeed, the Divestment Spectrum would be sufficient even for potential purchases* [sic] *who do not hold any 1800 MHz spectrum.* [emphasis added]"[52]

Thus, the Commission found that the very parties whose interests Ofcom is now seeking to promote could provide effective competition to EE in the provision of LTE services with access to a 2x15MHz carrier. Given these conclusions (which were subject to consultation with Ofcom), it is difficult to conceive how Ofcom now espouses a different view as to the minimum amount of spectrum necessary to create a credible fourth LTE operator.

Were the fourth mobile operator to have acquired successfully 2x15MHz in the 1800MHz band, it would already – in line with the reasoning of the European Commission – have acquired the spectrum necessary to deploy a credible LTE network. Plainly, if the fourth operator wishes to acquire additional spectrum, there should be no impediment inhibiting it from doing so. However, any decision to bid for additional spectrum will flow from the commercial and investment strategy that a fourth mobile operator will decide to pursue, based on its assessment of market conditions, likely consumer take-up of LTE services and its forecast subscriber base. In this situation, the fourth operator should no longer benefit from favourable discriminatory treatment and be shielded by the regulator from the competitive bidding process for spectrum in the 2.6GHz band.

Indeed, protectionism of this kind will be much more likely to lead to an outcome where a scarce resource is held by an undertaking that will not wish to exploit it in a way that will operate to the benefit of mobile consumers. Regrettably, Ofcom's current proposals neglect to assess the potential harm to consumers arising from an outcome where spectrum is reserved for an entity that is, for its own commercial reasons, unwilling to invest in its subsequent exploitation. There is a real prospect that if Ofcom's current

[52] Case No. COMP/M.5650, *T-Mobile/Orange* [2010] paragraphs 226-228

approach were to be adopted, it would raise the spectre of such an inefficient outcome. As such, Ofcom would be in clear breach of its duties stipulated by the Common Regulatory Framework and the Wireless Telegraphy Act 2006. The latter makes clear that the efficient management and use of spectrum are objectives that Ofcom must promote when performing its regulatory functions in relation to radio spectrum.[53]

In the circumstances, we would invite Ofcom to reconsider its approach and propose an alternative, less intrusive form of regulatory intervention along the lines proposed in this submission.

Annual Licence Fee Proposals – Compatibility with Ofcom's Community and Domestic Obligations

Vodafone welcomes Ofcom's recognition that annual licence fees cannot be determined in a regulatory vacuum as it initially appeared to indicate in its consultation document of March 2011. However, there is simply no evidence that Ofcom has demonstrated that its proposed revisions to the approach for setting licence fees takes into account or complies with the obligations mandated by Community and domestic law. As such, Ofcom's statement in section 8 and Annex 13 of its consultation document that its approach is consistent with these obligations is, at the present time, little more than an unsubstantiated assertion.

Accordingly, in spite of Ofcom's clarification and additional proposals described in its January 2012 consultation document, Vodafone continues to hold serious reservations about whether Ofcom's approach to the setting of annual licence fees can be deemed to be consistent with Ofcom's obligations under Community and domestic law. Specifically, Vodafone considers that Ofcom's proposals:

a. Are deficient in terms of providing a credible and compelling explanation for why Ofcom has departed from a well-established methodology for the setting of spectrum fees (based on the principle of opportunity cost);

b. Fail to recognise that the use of the values from the sale of the 800MHz do not provide a reliable indicator of the likely market value of 900MHz spectrum and therefore cannot form a justifiable basis for adopting a new approach to the setting licence fees;

c. Create a clear risk that they may distort a competitive bidding process and in so doing fail to promote the efficient use of spectrum;

[53] Wireless Telegraphy Act 2006, section 3(2)(a)

d. Are inimical to the principle of legal and regulatory certainty that is critical to the investment decisions of industry stakeholders such as Vodafone.

With reference to the legal principles that must be the leitmotif of a responsible regulator when setting spectrum fees, we examine each of these points below.

Legal framework

It is precisely because the level of the usage fees could, depending on the circumstances, distort the incentives of spectrum owners and consequently affect competition that the Community legislature has intervened a decade ago to ensure that NRAs are unable to set such usage fees in an arbitrary or discriminatory manner. In this respect, the provisions of the Authorisation Directive and the recitals underpinning them are instructive:

> "*Member States may allow the relevant authority to impose fees for the rights of use for radio frequencies or numbers or rights to install facilities on, over or under public or private property which reflect the need to ensure the optimal use of these resources. Member States shall ensure that such fees shall be objectively justified, transparent, non-discriminatory and proportionate in relation to their intended purpose and shall take into account the objectives in Article 8 of Directive 2002/21/EC (Framework Directive).*"[54] [emphasis added]

The terms objectively justified, transparent and proportionate plainly connote that the fees and implicitly the methodology employed to set them must be fully reasoned and capable of being scrutinised and understood by the industry stakeholders who may be affected by them. The final relevant limb of the criteria that is germane is the concept of proportionality, which requires the NRA to be satisfied that it has gone no further than is necessary to achieve its objectives; in this case, the efficient use of spectrum.

The Community legislature plainly recognised that there is a relationship between spectrum fees and competition, which is why it specifically tied the setting of such fees to the objectives of Article 8 of the Framework Directive (as amended), which provides that:

> *"2. The national regulatory authorities shall promote competition in the provision of electronic communications*

[54] Directive 2002/20/EC of the European Parliament and of the Council on the authorisation of electronic communications networks and services [2002] OJ L 108/21, as amended by Directive 2009/140/EC of the European Parliament and of the Council of 25 November 2009 [2009] OJ L 337/37 (the "Authorisation Directive"), Article 13

networks, electronic communications services and associated facilities and services by inter alia:

(a) ensuring that users, including disabled users, elderly users, and users with special social needs derive maximum benefit in terms of choice, price, and quality;

(b) ensuring that there is no distortion or restriction of competition in the electronic communications sector, including the transmission of content;""[55]

Further, Article 9 of the Framework Directive makes clear that the promotion of competition should be a primary objective in the management of radio spectrum:

"1. Taking due account of the fact that radio frequencies are a public good that has an important social, cultural and economic value, Member States shall ensure the effective management of radio frequencies for electronic communication services in their territory in accordance with Articles 8 and 8a."[56]

Alterations to the approach previously adopted by an NRA to the setting of spectrum fees are also subject to the same stringent regulatory safeguards, so as to prevent arbitrary behaviour on the part of the NRA at some point in the future:

"*Member States may need to amend rights, conditions, procedures, charges and fees relating to general authorisations and rights of use where this is objectively justified.*"[57] [emphasis added]

Thus, Ofcom is still required to provide a thorough and well-reasoned explanation for its proposal to adopt a new methodology for the setting of licence fees.

The final obligations that Vodafone considers relevant to the issue at hand are those imposed by Parliament upon Ofcom in the Communications Act 2003, which stipulate that Ofcom must give effect to a number of general principles whenever undertaking its regulatory functions:

In performing their duties under subsection (1), OFCOM must have regard, in all cases, to—

[55] Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services ("Framework Directive") as amended by Directive 2009/140/EC of the European Parliament and of the Council of 25 November 2009 [2009] OJ L 337/37, Article 8(2)(a) and (b)
[56] Framework Directive, Article 9(1)
[57] Authorisation Directive, Recital 33

(a) the principles under which regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed; and

(b) any other principles appearing to OFCOM to represent the best regulatory practice.[58]

Inherent in these general obligations laid down by Parliament is a duty upon Ofcom to promote legal and regulatory certainty when undertaking its role. Legal and regulatory certainty are critical for the investment decisions of the magnitude that industry stakeholders in the telecommunications sector must make. These principles assume particular importance in the period prior to the auction of additional spectrum whose outcome will determine the nature of competition in the next generation of mobile communications services.

In the hierarchy of duties and obligations to which Ofcom is subject when managing radio spectrum and usage fees, those stipulated in the pan-European Common Regulatory Framework (the "CRF") must, as a matter of law, take precedence over any other policy preference to which Ofcom may subscribe. Thus, as Vodafone has previously noted, the provisions of the Direction of HM Government must be construed in a way that is consistent with Community law. To the extent it is not possible to do so and that to give effect to the Direction would be to contravene the obligations of the CRF, then Ofcom must disregard the Direction.

Failure to provide clear reasoning for a decision to depart from existing AIP methodology

In spite of Vodafone's request that Ofcom provide clear reasoning for its decision to depart from an existing, well-established methodology (AIP) for determining the level of licence fees, there is no discernible justification provided. This justification is all the more necessary given that Ofcom provided no indication that its previous methodology failed to give effect to its obligations and duties under the Community law. In particular, Ofcom has failed to articulate how its revised methodology will be more apt than the existing one to attain its primary objectives to promote the efficient use of spectrum and the promotion of competition.

As noted above, the need for Ofcom to explain the justification for its switch in methodology is clearly intended and required by the Community legislature. The duty to provide clear reasoning is also a well-established principle in public and administrative law terms.[59] As things stand, Ofcom has failed to discharge its obligation to provide credible reasoning for its proposals.

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[58] Section 3(3)(a) and (b), Communications Act 2003

[59] *Padfield v Minister of Agriculture, Fisheries and Food* [1968] AC 997, per Lord Upjohn at 1061-1062: *"[I]f (an administrator) does not give any reason for his decision, it may be, if circumstances warrant it, that a court may be at liberty to come to the conclusion that he had no good reason for reaching that conclusion"; South Buckinghamshire District Council v*

As Vodafone has previously discussed, the terms of the Direction from Government, most notably paragraph 6, cannot in themselves provide Ofcom with an adequate basis for a decision to adopt the methodology proposed for the setting of licence fees. In the first instance, Ofcom's existing AIP methodology would already be capable of meeting the requirements of the Direction. Moreover, in simple terms, the wording in paragraph 6(2) of the Direction, *"must have particular regard to the sums bid for licences in the Auction"*, on its face cannot and does not mandate the adoption of any particular methodology to determine licence fees. But more importantly, the Direction could not in any case axiomatically compel Ofcom to abandon an existing methodology and adopt a new one along the lines contemplated. This is because Ofcom must first consider how to construe the provisions of paragraph 6(2) in a way that is compatible with the wider primary obligations governing Ofcom (described above) in managing radio spectrum.

Vodafone welcomes the fact that Ofcom has clarified that it does not intend to link mechanistically the values derived from the 800MHz auction to the setting of licence fees for 900MHz spectrum in future. Nevertheless, there remains a clear risk that slavishly giving effect to the provisions of the Direction in the way that Ofcom now proposes will still contravene the provisions of the CRF.

The use of 800MHz auction values is not a reliable basis for setting 900MHz licence fees

In the interests of brevity, Vodafone does not intend to repeat its submissions regarding the reasons why the price paid for 800MHz spectrum cannot form an input to a new approach for the setting of spectrum fees. Suffice it to say that Vodafone's submissions disclose that 900MHz spectrum cannot be regarded as a credible technical substitute for 800MHz spectrum. Indeed, Ofcom itself concedes as much in its own technical analysis of 900MHz spectrum elsewhere in its consultation. Given that 800MHz spectrum prices cannot provide a reasonable proxy for the value of 900MHz spectrum, a methodology that used the prices from the auction would be inherently unreliable and unsatisfactory. As such, it is difficult to understand how such a methodology is capable of satisfying the criterion of objective justification and of attaining the standard of robustness that is expected of Ofcom by both the courts and industry stakeholders.

What serves to further reinforce Vodafone's concerns about the soundness of Ofcom's current proposed methodology is that it creates the scope and incentive for rival bidders – who do not hold 900MHz spectrum – to drive up

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Porter (no 2) [2004] UKHL 33, per Lord Brown at 36. "*The reasons for a decision must be intelligible and they must be adequate. They must enable the reader to understand why the matter was decided as it was and what conclusions were reached on the "principal important controversial issues", disclosing how any issue of law or fact was resolved*." Whilst this proposition was made in the context of the duties upon public bodies making planning decisions, such approach would clearly be relevant and applicable in a case where Ofcom is obliged to provide an objective justification for its decision.

the value of 800MHz blocks in the auction. Thus the value attaching to the relevant 800MHz spectrum following the conclusion of the auction could therefore easily be an artificially inflated one. Given the inherent uncertainty and scope for unpredictable bidding behaviour in an auction process, the case for using the auction as a reference point for setting licence fees becomes even less credible.

As well as distorting the bidding incentives of parties involved in the auction, the link between the value of the 800MHz spectrum in the auction and licence fees may also have ramifications for the deployment of LTE services and future competition in the provision of these services. As we have highlighted earlier, bidders for the 800MHz spectrum may be forced, through the actions of other parties driving up the price of spectrum in this band, to divert the majority of their budget simply to ensure that they have acquired sufficient 800MHz spectrum. This may circumscribe their ability to acquire additional spectrum (for example in the 2.6GHz band) that they might otherwise have acquired in connection with the contemplated deployment of an LTE network. Such an outcome would plainly not produce an efficient outcome for mobile consumers; it would mean potentially that the additional spectrum did not find its way into the hands of those who valued it most (and correspondingly were more likely to exploit it in a way that would be in the interests of mobile consumers). On any analysis, such a result could not be deemed to promote the effective use of spectrum and competition in the provision of LTE services, both of which are mandated by the provisions of the CRF.

Ofcom's approach current approach is damaging to legal certainty

Ofcom's current approach leaves those holders of 900MHz spectrum in the invidious position of being uncertain as to the operation of the regulatory regime governing licence fees until some point after the conclusion of the auction process. However, in this case, the uncertainty about the operation of the regulatory framework is particularly troubling since it undermines Vodafone's ability to make the investment and strategic bidding decisions that are necessary for any party contemplating entering an auction process. Vodafone urges Ofcom to resolve this uncertainty speedily and well before the commencement of the auction process.

Concluding remarks

The above submission confirms that Ofcom's continuing link of the auction prices to the setting licence fees places it at odds with its obligations under the CRF and domestic law. In such circumstances, the prudent and proper course of action remains for Ofcom to adapt its current methodology for the setting of fees (based on the principle of opportunity cost) that will enable it to ensure that the auction is able to run freely and bring about the benefits for mobile consumers that Ofcom is obliged to promote.

Annex 4

Competition Credits

We present here a very simplified example of the use of competition credits. This illustrates our proposal that Ofcom should set an upper limit to the available competition credit as an alternative to guaranteeing a floor.

[Confidential].

Annex 5

H3G subscribers

Key Business Indicators

Key business indicators for the **3** Group businesses and HTHKH's 3G customers are as follows:

	Customer Base					
	Registered Customers at 28 March 2011 ('000)			Registered Customer Growth (%) from 31 December 2009 to 31 December 2010		
	Prepaid	Postpaid	**Total**	Prepaid	Postpaid	**Total**
Italy	5,844	3,252	**9,096**	4%	-1%	**2%**
Australia[1]	3,170	4,256	**7,426**	11%	9%	**10%**
United Kingdom	3,339	3,898	**7,237**	51%	7%	**23%**
Sweden & Denmark	252	1,654	**1,906**	29%	18%	**19%**
Austria	279	862	**1,141**	34%	23%	**26%**
Ireland	391	261	**652**	39%	27%	**34%**
3 Group Total	13,275	14,183	**27,458**	16%	8%	**12%**
Hong Kong and Macau[2]	628	1,581	**2,209**	151%	10%	**28%**
Total	13,903	15,764	**29,667**	19%	8%	**13%**

	Customer Service Revenue							
	Revenue for the twelve months ended 31 December 2010 (millions)					Growth (%) compared to the year ended 31 December 2009		
						Revenue		
	Prepaid	% of total Revenue	Postpaid	% of total Revenue	**Total**	Prepaid	Postpaid	**Total**
Italy	€343.1	20%	€1,362.3	80%	**€1,705.4**	-16%	10%	**4%**
Australia[3]	A$536.9	24%	A$1,664.5	76%	**A$2,201.4**	69%	6%	**17%**
United Kingdom	£169.9	12%	£1,234.5	88%	**£1,404.4**	12%	-7%	**-5%**
Sweden & Denmark	SEK192.3	3%	SEK6,280.6	97%	**SEK6,472.9**	47%	16%	**17%**
Austria	€7.4	4%	€199.9	96%	**€207.3**	48%	18%	**19%**
Ireland	€19.7	22%	€70.2	78%	**€89.9**	3%	22%	**17%**